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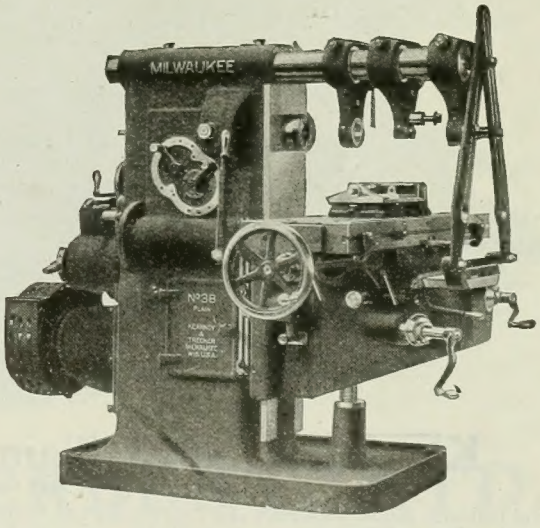

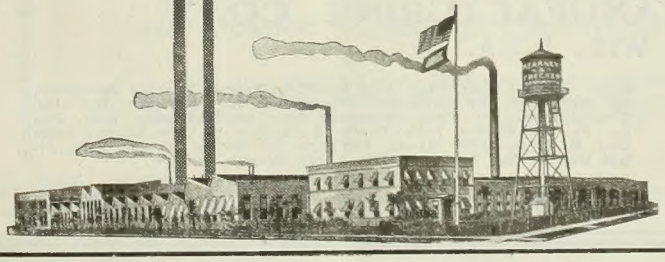

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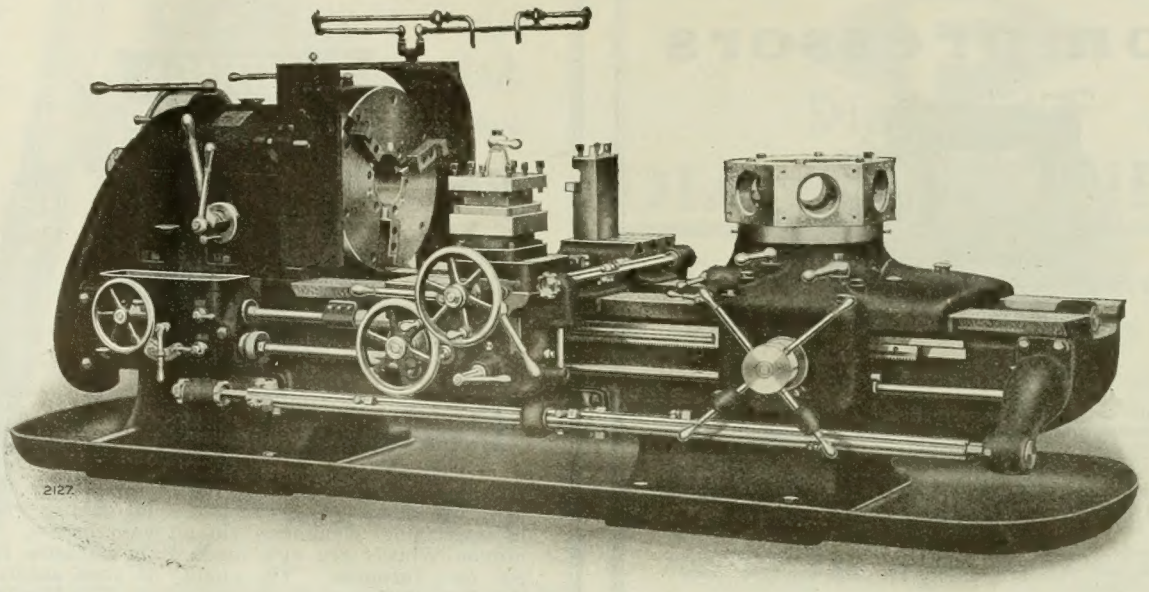

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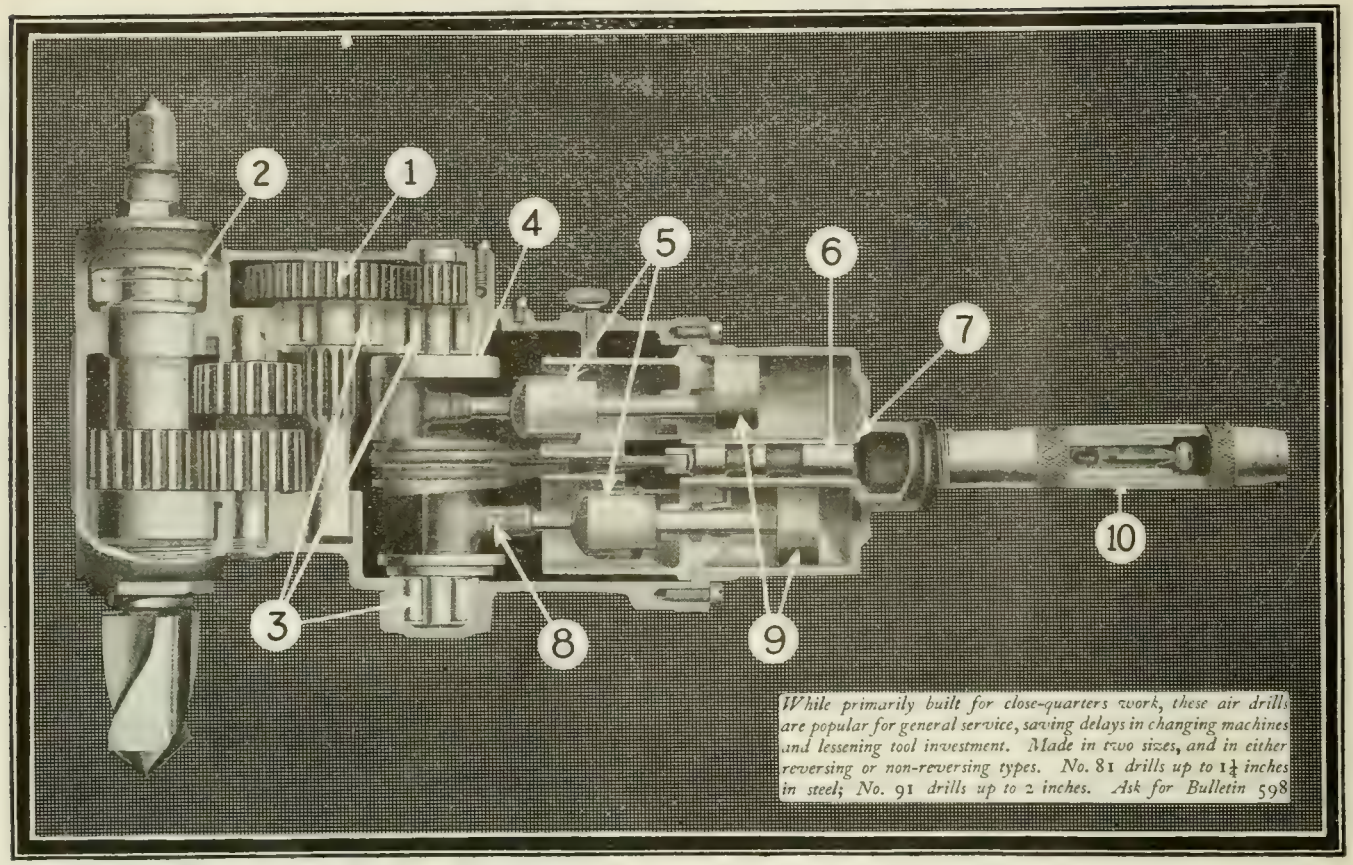

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3 Roller bearings support gear train. Ample provision for thorough lubrication of working parts by means of "splash" system.

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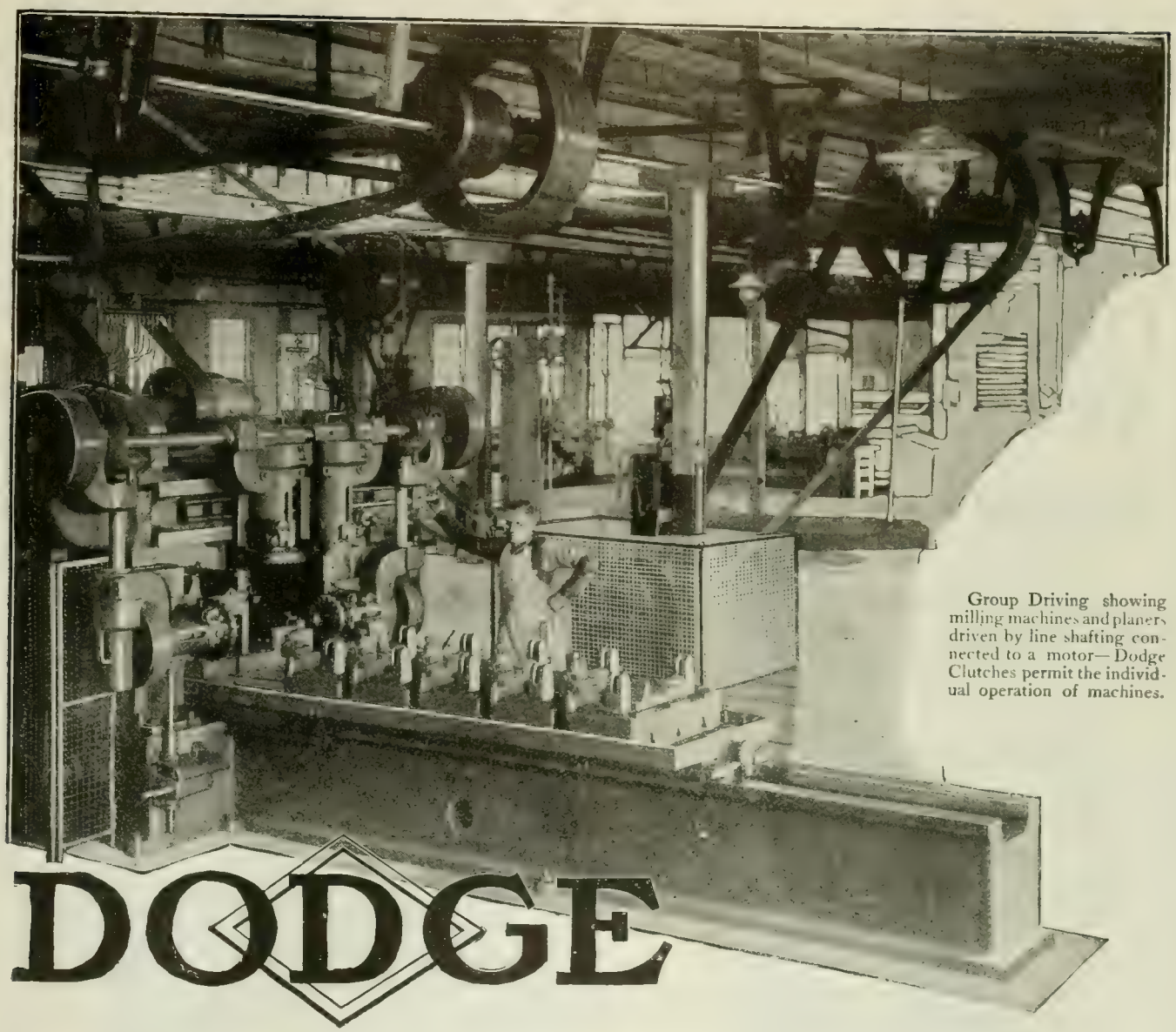

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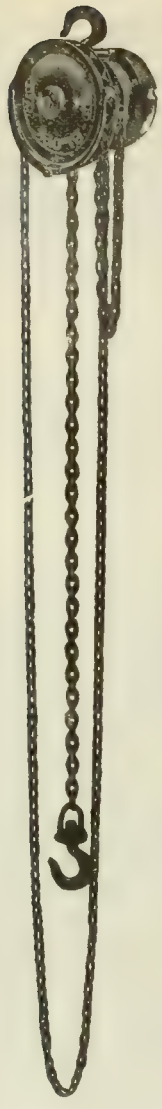

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CANADIAN MACHINERY
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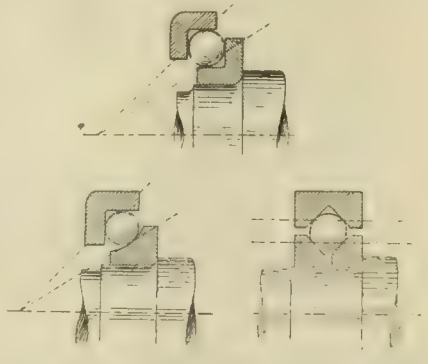
Ball Bearings and their Usefulness to Industry

Light Type Bearings—Evolution of Modern Ball Bearing — Thrust Bearings — Some Advantages of Ball Bearings.

By Gordon Janes

ACCORDING to the dictionary, a bearing is "that part of a machine which receives the friction." This being the case, it would be necessary to go back much further in history than any existing records permit, to ascertain when the first bearing was used. Nevertheless, from very early times—indeed, long before Archimedes, or even the Pyramids — the wastefulness of plain sliding friction was realized and the fact was appreciated that a weight could be moved with little effort on rollers or balls. But at this point progress in anti-friction science halted for many centuries, as it seemed impossible to find durable rolling members; and the cost of even the simplest anti-friction bearing deterred efforts in that direction until the advent of the bicycle.

The rise of the bicycle and the consequent need of conserving the very limited energy of its human motor brought forth numerous types of two, three and four-point ball bearings of cup and cone and other types; and for the very light service required, these types served very well. Some of these are illustrated in Figs. 1, 2, 3, 4 and 5. All are familiar and all share certain technical features. However, they are all distrusted to-day, due to their inability to endure the heavy loads or high speeds demanded in serious commercial work.



FIGS. 2, 3 and 4. SHOWING VARIOUS LIGHT SERVICE BEARINGS, ALL OF WHICH ARE NOW DISTRUSTED FOR COMMERCIAL WORK.

Thus, while the bicycle performed a great service to anti-friction engineering in making the ball bearing an accomplished fact, it, on the other hand, did much harm to the science, by creating an atmosphere of distrust as to the suitability of these bearings when applied to machines where the service required of them was heavy.

These ball bearings wore out rapidly, for several reasons, none of which were fully understood at first. Among the reasons was inaccuracy of form, which resulted in the load being supported by only one ball at a time. A second reason, which could not be overcome with the steels than in use, was the insufficient hardness of both balls and races. A third, was the failure to exclude dirt, which entered and acted as an abrasive, rapidly destroying both balls and races. A fourth reason was that the cup and

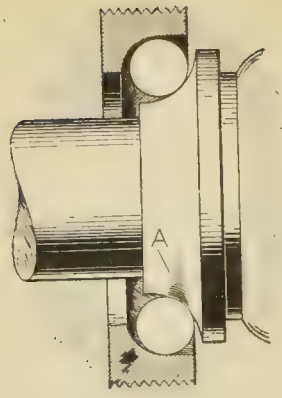


FIG. 5.—ANOTHER TYPE OF EARLY STYLE LIGHT TYPE BEARING.

cone designs first employed, whether of the two, three or four-point type, did not give the balls a pure rolling motion. There was always a spinning (and therefore rubbing) movement in addition. A fifth reason was that adjustability, once thought to be essential, proved to be a serious disadvantage, for no two users set their bearings alike. They either left them too loose or too tight, which compelled one or two balls to take all the load. This, of course, crushed both balls and races. The familiar cup and cone bearings of bicycles and other light machinery have been successful only because of the very light loads employed.

Evolution of the Modern Radial Ball Bearing

In 1898, Professor Stribeck commenced an exhaustive series of tests on the whole subject of ball bearing performance and design. Briefly stated, the tests, which extended over some years and cost a veritable fortune to make, showed that the condition of successful operation lay simply in the elimination of the usual factors of error, which until then had been deemed of no importance.

Since in a ball bearing the load is borne, not on a liberal surface, but by a few points whose area is due solely to microscopic flattening of the balls and races themselves, and since the loads at these points are not cushioned by an oil film, as in plain bearings, but are carried with direct metal to metal contact, it follows that the materials used must be of extraordinary toughness and hardness. From their very hardness, the balls and races are virtually incompressible, and it follows that errors, negligible in other machinery, simply will not do in ball bearings. If a ball is ever so little over size, it takes the load from its fellows, resulting in abnormal pressure at the points of contact. If undersized, it gets no load, with equally bad results. It is a fact that even a fine watch does not require such minutely exact construction as a durable ball bearing.

The need for uniformity does not end with matters of size and shape. The balls must likewise be uniform in hardness, both between ball and ball, and between different portions of the same ball. It will not even do to have a ball hardened merely on its surface. No two balls thus treated would have exactly the same compressibility, and no two would wear exactly the same. The only safe course is to have every ball hardened right through from surface to centre. A soft ball will show a coarse crystalline structure in its centre when fractured, with increasingly closer and finer grain toward the hardened surface. Some microphotographs of ball fractures are shown in Fig. 6, the right hand ball showing how fine and even a structure it is possible to obtain with proper methods of manufacture.

The relative position of balls and races and the shape of the races themselves underwent numerous changes before the present-day type of annular bearing was evolved. At first there were many attempts to employ a series of rows of balls but in none of these was proper provision made for taking care of the deflection of the shaft under load. After every effort to provide a proper load distribution had failed the simple plan of using a single row of balls was adopted. This resulted in a journal having no appreciable length and accordingly free from deflection. But as the number of balls in a single circle was necessarily limited, it became important to develop the carrying capacities, as affected by the shape of the ball tracks.

Frictional Resistance

It was found that the frictional resistance was best for balls rolling between straight line sections, or perfectly flat surfaces, giving two points of contact. Increasing the points of contact to three and four, produced higher frictional resistance without materially affecting the carrying capacity. Curving the raceway, however, resulted in an important increase in the carrying capacity. As many believed that the capacity of the bearing would be increased by employing more balls than could be introduced into the bearing by eccentric displacement of the races, various forms of filling slots were provided to accomplish this result. Other things equal, this would be true, but it must be remembered that the race cross section plays a vital part in determining the carrying capacity, and any device — such as filling slots, etc. — employed for the insertion of a larger number of balls than can be gotten into the bearing by eccentric displacement, weakens the race and hence results in a decreased carrying capacity.

To Conrad belongs the merit of eliminating the filling opening altogether, and providing an annular bearing of continuous race and uninterrupted groove. Incidentally, this eliminated all troubles due to interference between balls and filling opening. The bearing illustrated in Fig. 7 is the now familiar form of a single row, deep groove bearing manufactured under Conrad's patent. This type of radial bearing will also carry a considerable thrust—that is, load parallel to the axis of the shaft. The reason for this high thrust capacity will be seen from an examination of the race sections in Fig. 8, the groove in the right hand race being very deep.

In 1907, Mr. Sven Winquist, a resident of Sweden, invented and marketed a ball bearing which, owing to its design, is peculiarly adapted to practically all types of machinery, in that it embodies features which are unique and quite distinct from any other ball bearing designs. This bearing is shown in Fig. 9. As will be seen from the illustration, the inner race of the ball bearing contains two grooves, each ground

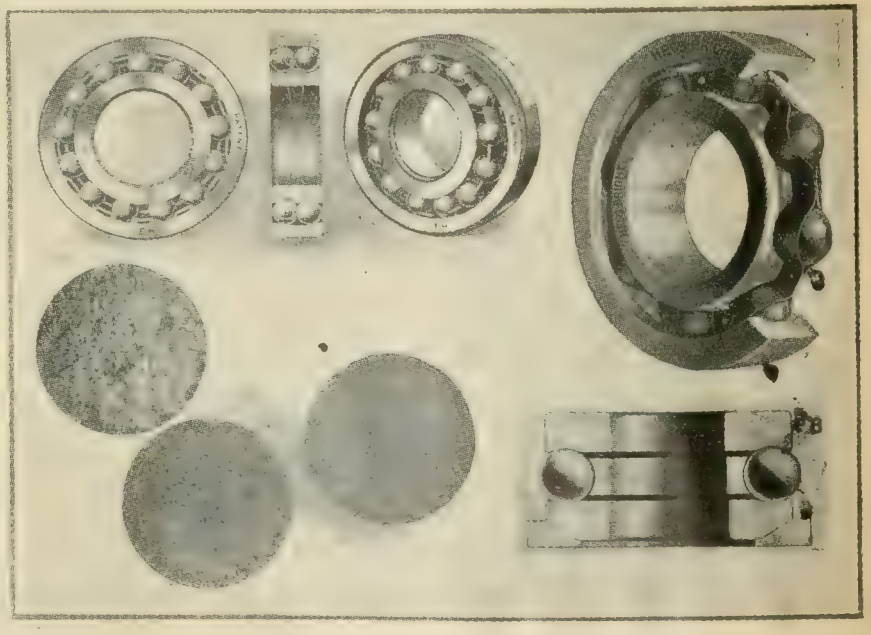


FIG. 9.—LEFT UPPER VIEW. FIG. 6. LEFT LOWER VIEW. FIG. 7 RIGHT UPPER VIEW. FIG. 11.—RIGHT LOWER VIEW.

to a radius slightly larger than the radius of the balls. The outer race is ground in the form of a section of a hollow sphere, whose centre is the centre

FIG. 13.

of the axis of rotation. As will be seen from Fig. 10, the two rows of balls and inner race are free to rotate at any angle within this spherical outer race without subjecting the races to any undue strains, allowing a perfect ball and socket or self-aligning action. The ease with which this bearing functions under all conditions of shaft misalignment will be appreciated when it is pointed out that the balls roll on the surface of the spherical outer race with a pure rolling motion.

Thrust Bearings

For carrying thrust, that is, load parallel to the axis of the shaft, a special form of bearing called a "thrust" bearing is employed. In this, the ball tracks are arranged in planes at right angles to the shaft axis and ground concentric with the bore of the bearing to a radius slightly larger than the radius of the balls. In order to secure the full carrying capacity, the two thrust plates or collars must be absolutely parallel. Even so small a deviation as a few ten-thousandths of an inch will concentrate the entire load on a few balls at one side — overload these — and reduce the bearing capacity. Therefore, to secure exact parallelism between the shoulders on the shaft and the housing seat, even under deflection, and the small yet important and unavoidable errors of workmanship, one collar is generally given a spherical surface on the outside, which permits it to adjust itself in the corresponding spherically machined seat of the housing and thus secure the exact parallelism required.

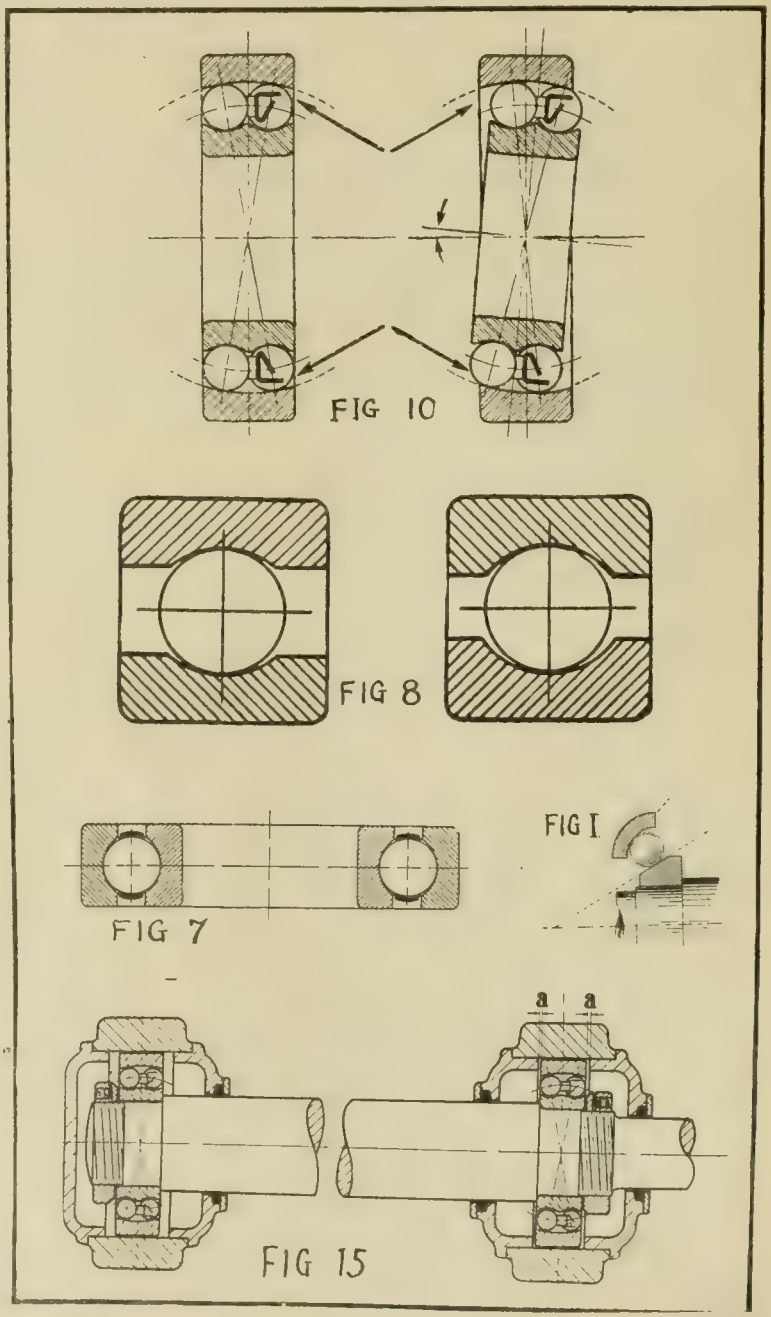
Fig. 11 is an example of a single thrust, self-aligning bearing. The drawing shows this provided with a spherically-ground washer which permits of the bearing being mounted in a flat seated housing without special and difficult machining. It will be noted that the upper ring has a smaller bore than the lower and revolves with the shaft to which it must be securely fixed. Of course, self-aligning thrust bearings are not always essential and in that case both collars are plain rings similar to the upper collar of the bearing shown in Fig. 11. Such a bearing works well, provided it is accurately lined up when first mounted and there is no opportunity for the shaft to deflect while in operation.

The bearings just described are both of the single thrust type—that is, they take load in one direction only, but cases often arise when the load may have to be carried from either side requiring a bearing of what is called the double thrust type. Such a bearing consists of three rings or collars with two sets of balls—the middle collar of the group being the one to grip and revolve with the shaft and the two outside collars resting in the housing. As in the single thrust bearing, these outer collars may be spherically ground to make the whole unit self-aligning. The centre of this spherical assembly coincides with the axis of rotation. The bearing illustrated in Figs. 12 and 13 is a self-aligning, self-contained double thrust unit. It possesses the great advantage of being easily mounted since there is only one part to handle, and the accurate and, therefore, costly, machine work, often required is greatly reduced.

Some Advantages of Ball Bearings

A great advantage of ball bearings is the saving of power. The University of Wisconsin made a test some time ago which illustrated that roller bearings required the least amount of power, and that an increase in speed had little effect on the bearings.

As the motion in an annular ball bearing is one of pure rolling, the starting



FIGS. 1, 7, 8, 10 AND 15. NOTE FIG. 15 IS USED ON PART 2, AND IS NOT DESCRIBED IN THIS PORTION. FIG. 7 IS A SECTION OF THE VIEW SHOWN IN PHOTOGRAPH ON PAGE 34.

friction is no greater than the running friction. This is a very important fact, for as it is not necessary to provide for heavier starting loads, a much smaller motor may be used. Shafts in cast iron, babbitt or bronze bearings frequently become "set" if the equipment is idle for any length of time. The oil is pressed out of these bearings and it is extremely difficult to start the shaft from rest. In addition to the saving in power, there is a saving in lubricant, due to the fact that the oil or grease is sealed in the bearing chamber, which is of sufficiently large dimensions to contain enough lubricant for many months' running. A direct result of this is increased cleanliness and freedom from the annoyance of dripping oil. The bearings, being enclosed in dust-proof housings, can be run under conditions of dust, moisture and grit that would quickly spell ruin to a plain bearing. In a later issue we will consider the mounting and installation of ball bearings.

MORE TO FOLLOW

The author of this article is Toronto manager for the SKF Ball Bearing Co., and is naturally an authority on the subject. He has had a varied experience in ball bearing installations, and will tell us in his next article about different types of machines that have been successfully equipped with ball bearings. This will appear March 17th, and is well worth watching for.

Two Ideas That are Well Worth Remembering

BALL BEARINGS

Finding Diameter of Ball Race

Herewith are diagram and data for finding the diameters of ball races, when a certain number of balls of a given diameter are to be used, all balls touching.

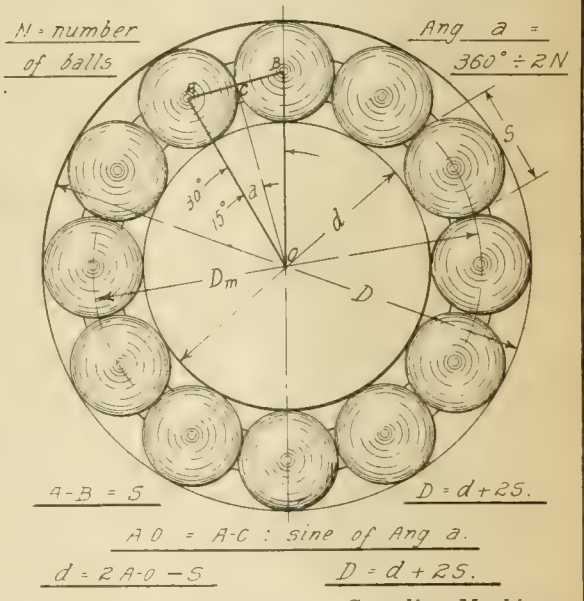
Example:—Twelve 7/8-inch balls are to be used in a radial bearing; what must be the two diameters d and D, when all balls just touch each other?

AB = S the diameter of the ball.

$$AO = AC \div \text{Sin of angle (a)}, \text{ or } \frac{.875}{2} \div .25882 = 1.69 \text{ in.}$$

$$\text{Diameter (d)} = \frac{2AO}{S} = 3.38 - .875 = 2.505 \text{ in.}$$

$$\text{Diameter D} = d + 2S = 2.505 + 1.75 = 4.255 \text{ in.}$$

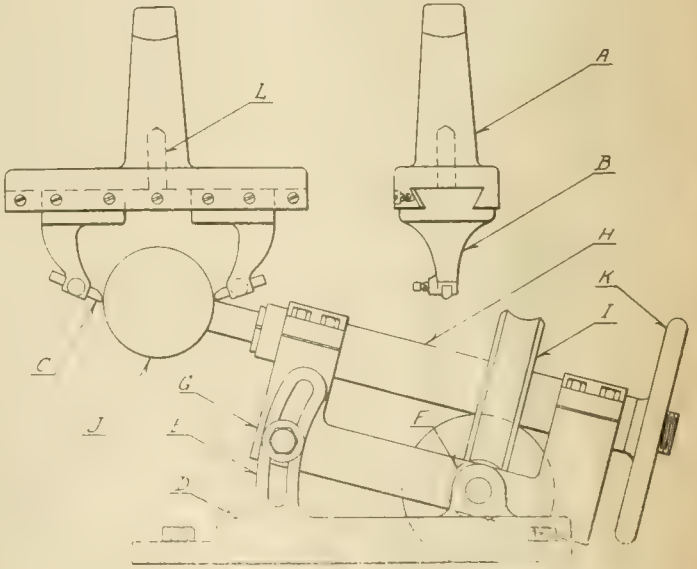


Canadian Machinery

BALL TURNING

Fixture for Turning Balls on a Drill Press

Shank A, which fits the drill spindle, is provided with slide to carry the two adjustable tool blocks B. Tools C may be set equal distance from the central line by means of a rod in the hole L. Base of holding fixture D has a slotted quadrant E, which permits incline adjustment. Head G swivels from the shaft that carries the worm F, the latter meshing with worm gear I keyed to the hollow spindle H. Collet chuck and draw spindle (hollow) is fitted inside of H, for holding work, secured by means of wheel K. Fixture may be revolved by hand, or by pulley placed on worm shaft. Tools are slowly fed to the work while spindle revolves.



Canadian Machinery

CHARTS OF SIMILAR NATURE TO THE ABOVE WILL APPEAR EACH WEEK.

Advisability of Standardizing Jig Design

By Robert Mawson

ANYONE who has followed machine shop practice during the past few years, say a decade, will agree that the greatest change has been in duplicate machinery operations. About ten years ago special tools such as jigs and fixtures were the exception rather than the rule in most plants.

The automobile industry has been the great leader in this matter. The writer can well remember where, in the early stages of automobile making, each part was made by trial to fit other components. One can readily see what this meant when repair parts were necessary —the question of repair was then almost a tool room proposition.

Let me cite one case that was followed out in our plant. We had certain cylinders that were cast in pairs. The sequence of operations when machining the bores to suit the pistons was as follows: They were first roughed out with a one point tool, which was then followed with a multiple tool; in other words, a bar having a number of cutting tools. The holes were next reamed approximately to size. A long cast iron lap charged with abrasive and oil was then moved by hand up and down the bored hole until the surface was smooth and brought to size. Each piston was then fitted to one of the holes in the cylinder, and woe be to the workman if he should get these mixed or misplaced, as we scarcely ever found two just the same diameter.

Somewhat similar haphazard methods were also used for other operations, such as milling and drilling. On drilling operations, the earlier method was to lay the positions out with height gauges, etc., the operator working to guide lines when machining. The next development was the use of templates for the drilling operations, but at best these are only makeshifts, as their accuracy depends largely on the care exercised by the man using them.

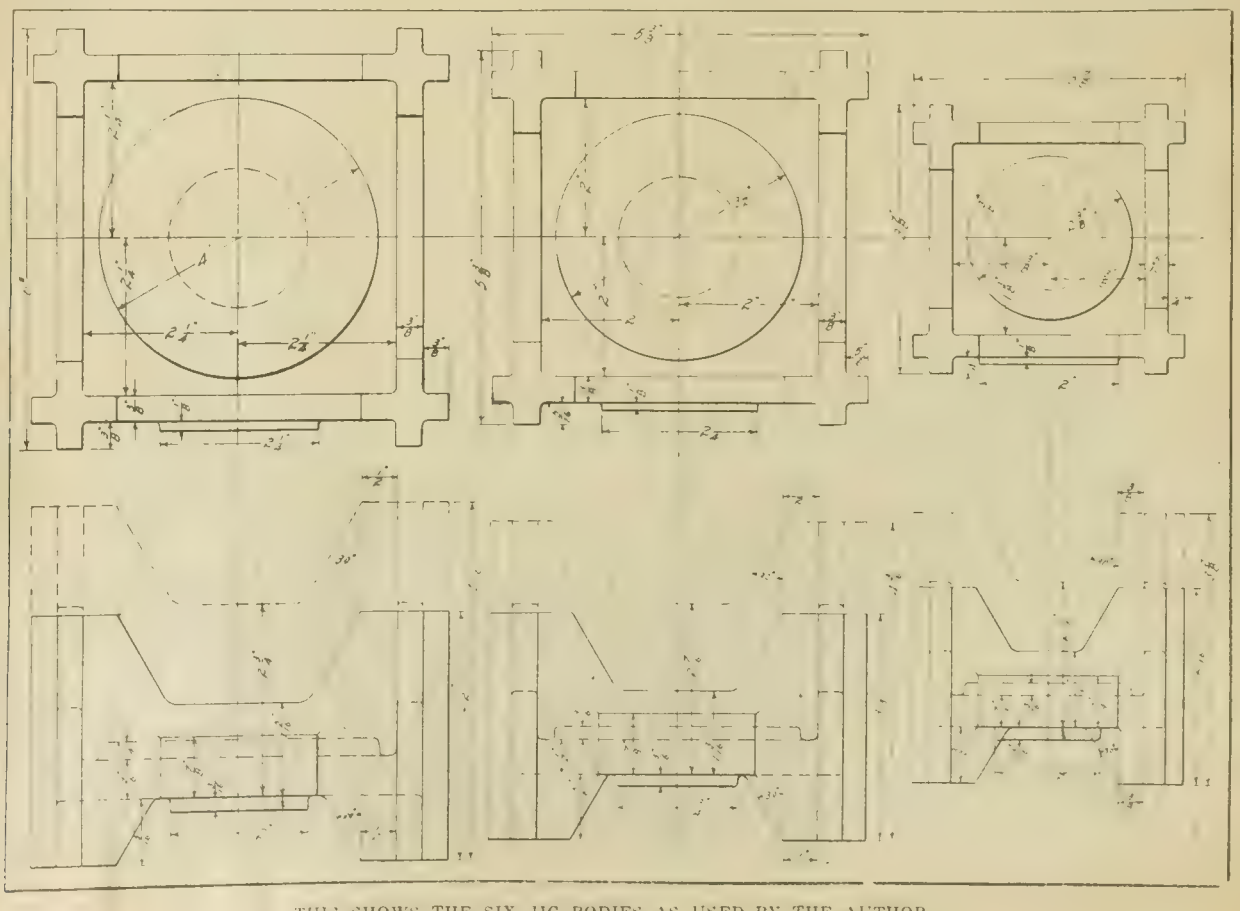
As the automobile and other machine building developed, and in order to meet the demand for new and repair parts, the need of special machining tools was created. This demand also provided for a new profession in the engineering field, namely, tool designers.

This work is quite different from the machine designer's who deals largely with known factors, such as friction, stresses, etc. The tool designer is called upon to deal with an unknown factor—the human element. To meet this requirement he must use very generously his common sense. For this reason, jigs, fixtures, etc., are made fairly heavy and rigid—stresses do not enter into the question. Further, tools should be made as near as possible FOOL PROOF. There are still a few of these people left in the machine shop, and one might be called upon to use the tools.

Some tool designers come via the machine designer route, whilst others step up from the machine shop and tool room. This is perhaps unfortunate in both ways; the designer does not know all he should know about the shop end, and the shop man is usually lacking in designing knowledge. This condition, no doubt, accounts for many of the freakish tools often seen in service.

The question of making patterns for tools is also a matter for consideration. Often only one tool is made from a pattern, which makes the proposition a

Continued on Page 41



THIS SHOWS THE SIX JIG BODIES AS USED BY THE AUTHOR.

Turret Lathe Applications

The tooling necessary for machining an axle housing, a motor frame, and a piece of work weighing over 600 pounds.

BY J. H. MOORE

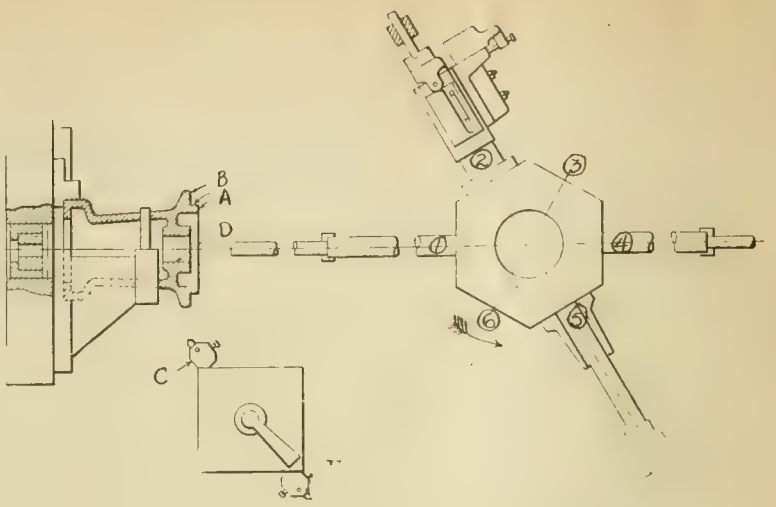


FIG 2—LAYOUT OF TOOLING USED IN FIRST OPERATION

TOOL layout is a study of extreme importance if the best results are to be obtained from any style of turret lathe. This article depicts various examples of work performed on Gisholt turret lathes, and illustrate the benefits of a well planned layout.

At Fig. 1 is shown an axle housing that is used on a tractor. The portions machined in the turret lathe are marked in heavy lines on the sketch. Owing to the irregular shape of this piece, a special fixture, or chuck bonnet as it is often termed, is employed in the second operation for holding the work. The housing is made of cast iron, and the work about to be described was performed on a 24-inch machine.

At Fig. 2 is shown a diagram of the tooling equipment used on the first operation. This work consists of machining the front end of the housing, also boring and reaming the hole. The operations are completed as follows: The housing is held in a special fixture which has an arm that encloses the work, and steadies it near its outer end. This arrangement can be clearly noted at Fig. 2, although Fig. 3 illustrates the fixture still better.

The surfaces A and B are first rough turned and faced with the tool C in the toolpost. The hole D is next rough bored with the cutter held in boring bar at position 1 of the turret. Reference to Fig. 3 will show this bar starting its cut. The hole D is now finish bored with the cutter in the boring bar at position 4 of the turret. In both the rough and finish boring operations the bar is guided by means of a pilot that enters a bushing in the chuck. This bushing is clearly shown at Fig. 2.

The hole D is next reamed with the reamer at position 5 of the turret, after which the surface B is finished with cutters held at position 2 of the turret. During this operation the head is steadied by a bushing on the end of a pilot. This bushing enters the completed hole D, and ensures the concentricity of the

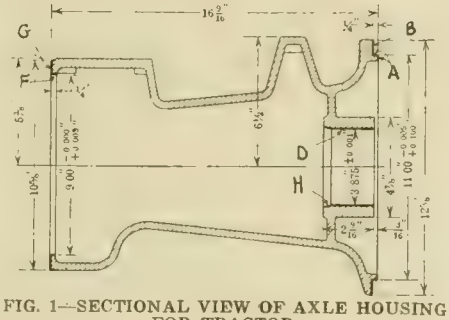


FIG. 1—SECTIONAL VIEW OF AXLE HOUSING FOR TRACTOR.

surface at A. The shoulder B is next finished with the tool E held in the toolpost. This completes the first operation, and the time expended is 8 minutes.

Second Operation

The second operation layout is shown at Fig. 4, and this work consists of machining the surfaces F and G, also chamfering the portion H, together with tapping the hole J. As already stated, a special chuck plate to hold the work, this plate being attached in turn to the regular faceplate of the machine. The method of holding the work is clearly seen in Fig. 5, which is a close up of the fixture we speak of. The method of carrying out the steps of operations are as follows:—

The housing is mounted on the chuck plate as shown, and held with clamps. The surface G is rough faced with the tool L held in the toolpost. The hole F is next bored and a chamfer produced at H by means of the cutters held in the head at position 1 of the turret, the head being guided by means of pilot that enters the bushing K in the chuck plate. The surface G is now finish faced with the tool H held in the toolpost. The hole at J is the final step, and this is tapped with a tap mounted at position 4 of the turret. The complete operation takes 6 minutes to perform.

Machining Motor Frame

The next example, Fig. 6, is that of a motor frame machined on the surfaces shown by the heavy lines. Two operations are necessary to complete this piece, and the auxiliary toolpost of the lathe is brought into play as well as the turret and regular toolpost tools. This work is also produced on the 24-inch size of machine. The piece is made from cast steel, and the tool layout for the first operation is shown at Fig. 7. At Fig. 8 is depicted the method of holding the motor frame during this operation.

FIG. 3. BORING THE HOLE IN FIRST OPERATION.

FIG. 5. HOLDING THE WORK IN SECOND OPERATION.

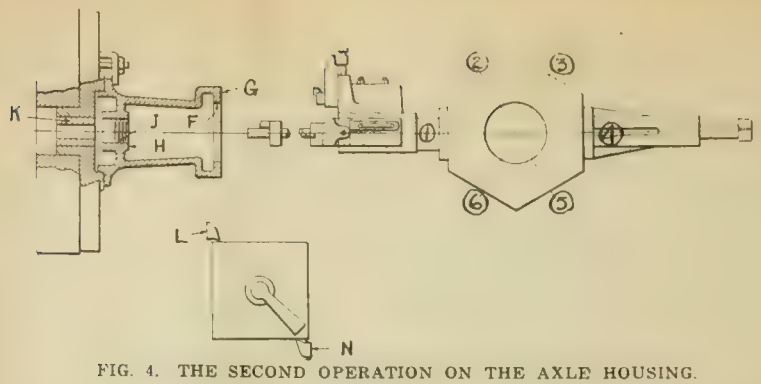


FIG. 4. THE SECOND OPERATION ON THE AXLE HOUSING.

Here are the steps followed during the first operation.

The work is held in place with special hard chuck jaws, these having clamping screws as shown at Fig. 7. The surfaces A and B are rough bored by the tool C in the toolpost. The surfaces E, F and G are next rough turned and faced by the tool D in the toolpost. After this the outside of the housing at H is rough turned with the tool J held in the wing rest. The outside H is then finished with the tool K held in the wing rest.

The hole L is now rough and finish bored with the cutters held in bar at position 1 of the turret. The end of this bar is piloted in the bushing in the chuck shown at Fig. 7. A second roughing cut is next taken on the surfaces A, B, E and F with the cutters in the head at position 2 of the turret. After this is completed the surfaces A, B, E, F and G are finish turned with the cutters in the head at position 5 of the turret. It will be noted that both these heads, that is, at position 2 and 5, are guided by pilots that enter the bushing in the chuck, also with a bushing that enters the bore L. This arrangement guarantees that the finished surfaces will be concentric. The total time on these various steps is 35 minutes.

Second Operation

The diagram for the second operation is shown at Fig. 9, while the photographic view of the same operation is shown at Fig. 10. The work is held on a special chuck plate as shown, clamps securing the piece tightly. After this is done, the work goes through the various steps.

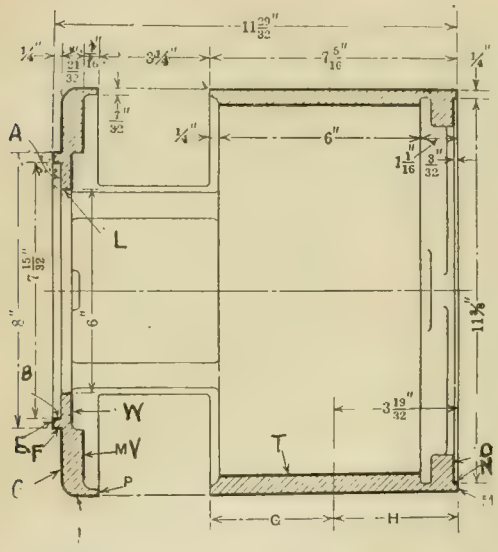


FIG. 6.—SECTIONAL VIEW OF A MOTOR FRAME.

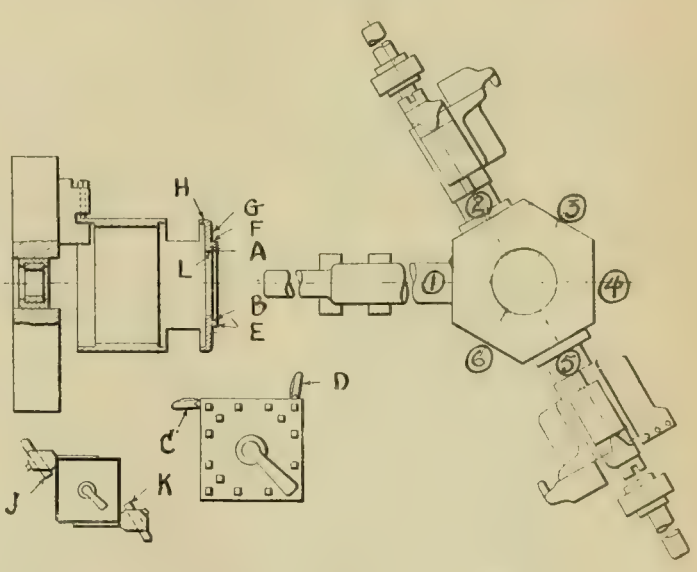


FIG. 7.—TOOL LAYOUT FOR FIRST OPERATION ON MOTOR FRAME.

The motor frame is first centered on the chuck plate and the clamps tightened. When this is completed the surfaces M, N and O are rough machined with tool P in the toolpost. The outside surface R is turned with tool S in the wing rest, and the bore T is started with

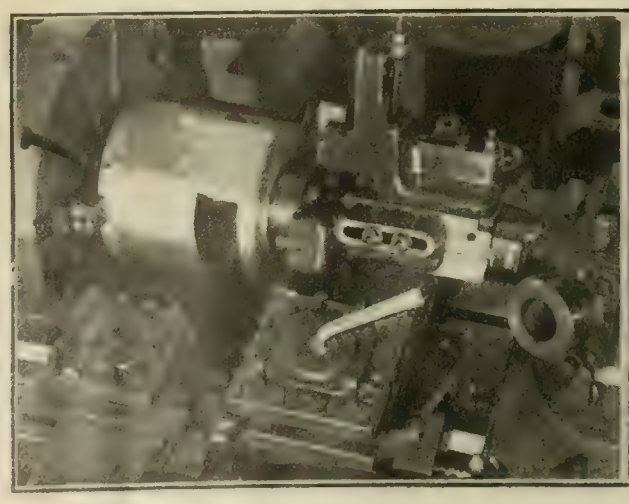


FIG. 8. VIEW ILLUSTRATING HOW MOTOR FRAME IS HELD IN FIRST OPERATION.

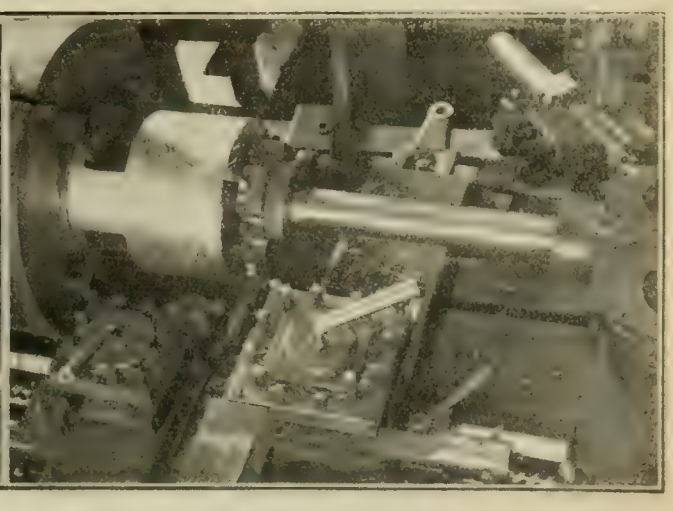


FIG. 10.—THE METHOD OF HOLDING THE FRAME IN SECOND OPERATION.

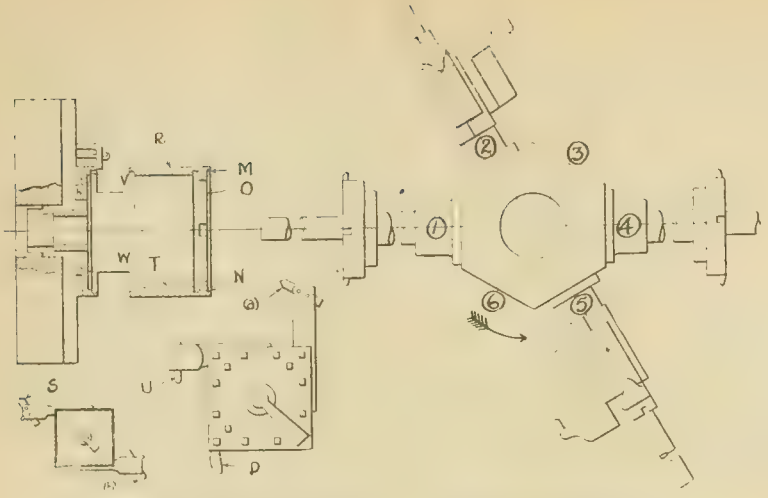


FIG. 9. SECOND OPERATION ON THE MOTOR FRAME.

the tool V in the toolpost. The bore T is now rough bored with the cutters held in the head at position 1 of the turret, and the same hole is finish bored with the cutters held in the head at position 4 of the turret. Both these heads are guided by a pilot that enters the bushing mounted in the chuck as shown at Fig. 9.

The surfaces M, N and O are next rough turned with the cutters held at position 2 of the turret, and the same surfaces are finished with the cutters in head at position 5 of the turret. The shoulders V and W are finished with the tool (a) held in the toolpost, while the outside surface R is finish turned with the tool (b) held in the wing rest. This completes the operation and the time consumed on this work is 45 minutes.

Machining Heavy Work

The remaining example in the present article is shown at Fig. 11. The drawing depicts a very large piece of work that weighs over 600 lbs., and is made from cast steel. It is machined on a 28-inch machine, and shows clearly the possibilities of handling large work on such a type of machine. This example also illustrates the benefits of using multiple tools for boring different sizes of holes.

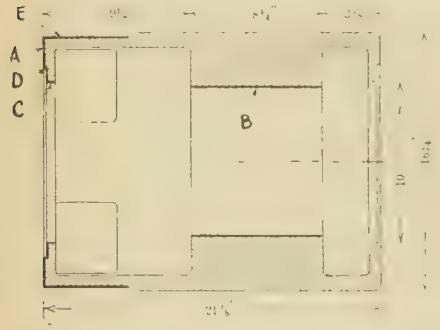


FIG. 11.—AN EXAMPLE OF HEAVY WORK COMPLETED ON A TURRET LATHE.

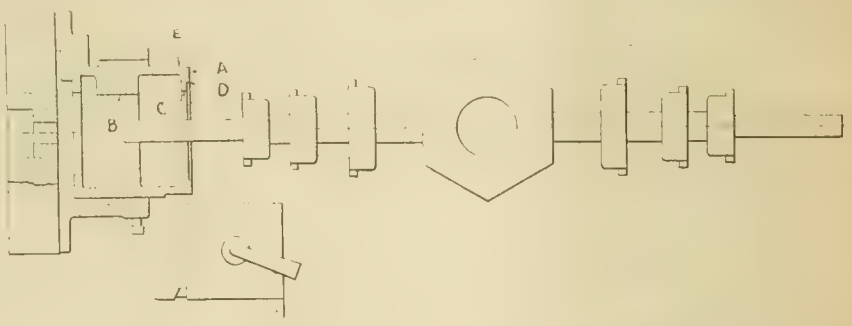


FIG. 12.—THE TOOLING EQUIPMENT USED IN THE FIRST OPERATION ON THE PIECE SHOWN AT FIG. 11.

The tool layout for this part is shown at Fig. 12, while the photographs, Figs. 13, 14, 15 and 16, illustrate other particulars regarding the work being performed. Let us consider the work step by step.

Two operations are necessary to complete this part, and the first of these proceeds as follows:—

A special fixture is used to support the casting, and this is of the sometimes termed, bonnet design, being so called because it bonnets or gives support to the casting at a considerable distance from its end. The end A is first faced with a tool held in the toolpost, after which the holes B and C are rough bored. The counterbore D is now rough machined with the multiple tool heads held in the turret. The bar on which these heads are held is guided by a bushing in the chuck as shown at Fig. 12.

At the same time as the casting is being rough bored, the outside of the casting at E is rough turned with the tool held in the toolpost, after which the same surface is finish turned. Upon this being completed the holes B and C, also the counterbore D, are finished with the multiple cutter heads in the turret. These heads can be noted at Fig. 14.

Second Operation

In this operation, the casting is held on a face-plate that is provided with clamps. Both the face plate and the clamps can be clearly noted at Fig. 15. The work after being located and clamped in position is shown at Fig. 16.

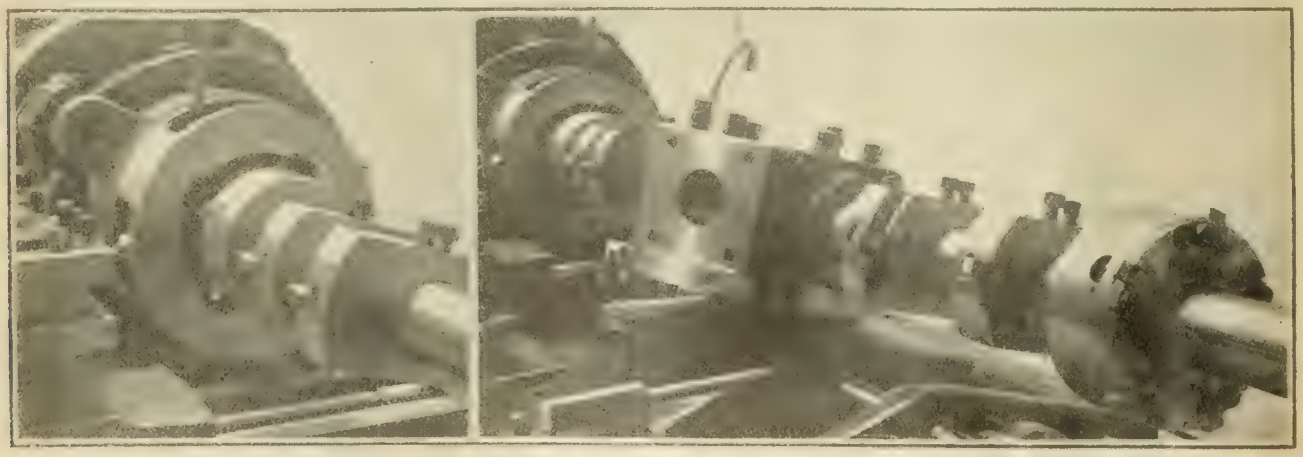


FIG. 13. SPECIAL FIXTURE FOR HOLDING THE WORK.

FIG. 14. FIXTURE AND MULTIPLE TOOL HEAD USED ON SUCH WORK.

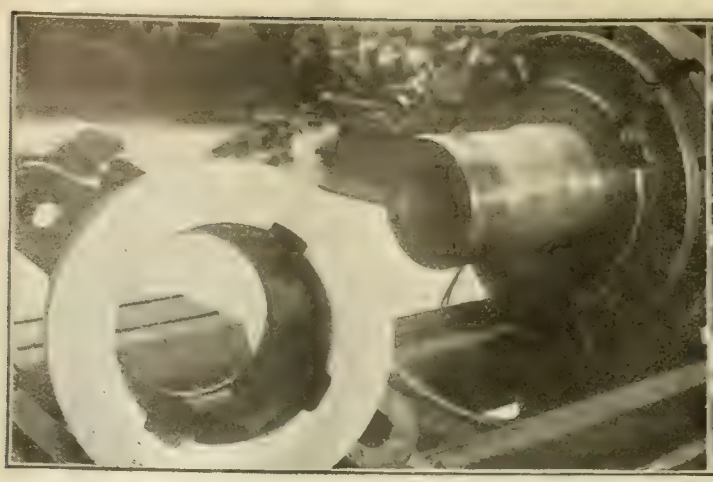


FIG. 15.- METHOD OF HOLDING PIECE DURING SECOND OPERATION.

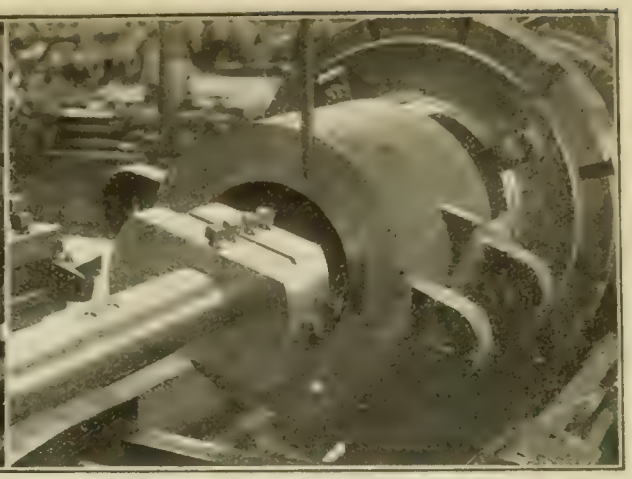


FIG. 16. NOTE THAT THE CASTING IS CLAMPED IN POSITION ON THE CHUCK PLATE.

This operation consists of facing the end of the casting with the tool held in the toolpost, also boring and counterboring the piece at the end by means of a double head boring bar as shown at Fig. 16. As these operations are self-explanatory we need not dwell on the same. Sufficient to say that the total time for both operations is 70 minutes.

This completes the present article, but in a later issue we will present further examples of good turret lathe practice.

STANDARDIZING JIG DESIGN

Continued from page 37

costly one. Another point is this: Through lack of shop knowledge, some tools are designed which are difficult to machine. Some weak points in design are often apparent, which could be easily remedied if the designer possessed the required knowledge. I well recall seeing a jig which had been made with small pins for the feet, these being of such a size that they were constantly dropping into the slots of the vertical drilling machine table.

In order to meet emergencies such as I have briefly outlined, we recently designed a set of jig bodies, six of which are illustrated at Fig. 1. It will be seen that these tools may be used on six surfaces, the four sides, top and bottom. Wide bearing surfaces are provided, these being of a cross section so that the tool cannot foul in the slots of the table. The sides are cast low, so that chips may be easily removed, and the various bosses are raised so that machining is easily and conveniently performed.

A number of these various jig bodies are carried in stock, and when a jig is to be designed the draftsman lays out the outline of the jig body, taking the size most convenient. The various screws, straps, etc., are shown in position, and their correct locations determined. After the design has been duly finished and checked, it is sent to the tool room in the usual manner. All the various standard parts used on the tool are called for, any special part as straps being detailed separately on the drawing. The jig bodies are designated by number, as "stock body No. 4," and so on.

The tool maker, therefore, goes to the tool room stores and asks for the jig body casting at the same time that he calls for standard parts used. He is then in a position to make up the tool quickly, without inconvenient waits for either the pattern or casting. A further advantage is that the tool maker gets accustomed to machining this type of jig, and knows how to do the various operations to the best advantage, which is also true regarding the manipulation of the tool in service. We do not require a man to go around the shop to illustrate to the operators the correct method of using various types of tools, as this style can be adapted to a large variety of parts. The design is good in principle, the pattern can be cheaply made, castings are easily produced, and the tool room operations are simplified.

THREE ESSENTIALS

There are three important and essential characteristics which coke for metallurgical purposes must possess, says the Chemical Trade Journal. First, it must be hard and resistant to the abrasive forces to which it is subjected in the course of its transport from the coke oven to the foundry, and it must be able to withstand the crushing strains arising from the weight of the superincumbent charge in the furnace.

Second, it must contain a low proportion of ash, sulphur, and phosphorus—the limiting values demanded under normal conditions by many ironmasters are: ash, 10 per cent.; sulphur, 1 per cent.; phosphorus, 0.05 per cent.

Third, as the coke in certain zones of the blast-furnace reacts with an upcoming stream of carbon dioxide, it is an essential to the smooth working of the furnace that the coke possess a certain porosity, in order that a large surface may be exposed for interaction with the gas.

NEW TYPE FURNACE

A rather novel type of electric furnace has recently been introduced in America. This furnace is known as the Von Schlegell repelling arc type, and two electrodes are suspended in the furnace chamber, being drawn together nearest the hearth by adjustable weights. As soon as current flows the repulsion between the electrodes forces the two ends apart, thus drawing out the arc. The repulsive forces also drive the arc down towards the charge. The electrodes being approximately parallel when in the operating position, the relative position of their ends is not affected by the wearing of the electrodes, or the melting down of materials. It would appear that all other changes are immediately compensated for by the fact that every decrease in current allows the ends of the electrodes to come closer together, and if any influence should break the arc, it immediately re-establishes itself. Unusual smoothness of operation is, of course, the chief claim. Three of these furnaces are being used in melting non-ferrous metals, and one is employed in the production of aluminium steel.

A project to bring coal from the anthracite regions in Pennsylvania to New York through two 14-inch pipes, by water pressure, is being considered by the city Dock and Health Commissioners. This seemingly wild plan was submitted by Mr. Reginald P. Bolton, a member of the American Society of Mechanical Engineers. Mr. Bolton explained that between Scranton, Pa., and New York there is a fall in elevation of about 2,000 feet, and that it would be as easy to transport coal in this fashion as by water. He estimates that 7,000,000 tons of coal, which would amply supply the city's needs, could be brought through the pipes every year.

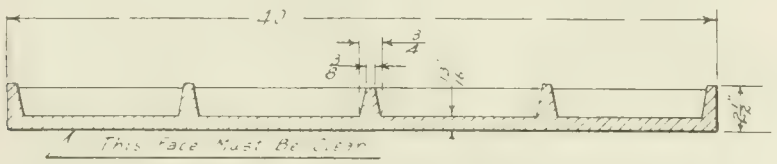
The general contract for erection of repair shop for Pease Foundry Co., Lyon Street, Ottawa, has been awarded to J. Walker, 151 Strathcona Avenue.

Points in the Production of Surface Plates

By Donald A. Hampson, Member, A.S.M.E.

AN EASTERN shop makes a great many special cast iron table tops, or surface plates, and the methods they have adopted are full of interest. A cross section is shown of a typical size which is 40" x 64". These plates are not as deeply ribbed as the surface plates used for scraping bearing surfaces —they have an average thickness of two inches and a rough casting of the size mentioned above weighs 650 lbs.—only about a quarter of what a machine tool surface plant of same area would weigh —this lack of metal has a direct effect on the casting all the way from the foundry to the packing room and calls for different handling on the planers.

Because the "face" of the plate must be clean, it must be cast down, which means that all of the sand forming the pockets between ribs must be suspended in the cope. Wood patterns are used, but these have metal "veneer" attached to a number of ribs to keep the patterns straight. Plenty of draft is allowed and one moulder is able to make a plate a day with such help as is required in turning and lifting flasks. Foundries doing this kind of work have to experiment to get results, just as a machine shop has to try out methods before getting into production. A good grade of pig must be used and this must be heated extremely hot to avoid cold shuts from the long distances the iron has to run in the thin flat bottom space of the mould. A most important phase of the work follows the pouring, i.e., the uncovering of the casting, which must be done a certain section at a time so that the cooling of the wide



SECTION OF SURFACE PLATE AS IT IS MOULDED.

flat solid part does not warp the whole, for the ribs themselves are relatively shallow and not strong enough alone to keep the piece straight.

Inspection for Warp

Received in the shop, the first move is to inspect for an excess of warp—the foundry is apt to take a chance on a crooked plate that represents $50 on the bills and send it out though they know it is poor. Then the edges of the casting are cleaned, painted and filled. Two or three holes—depending on the size of the plate—are drilled in each end of the castings; these holes are for the clamps and are put in with an electric drill. The castings are now ready for the planer hand and when he is through they require only a coat of paint around the edges to make them ready for packing.

The foundry delivers all castings upside down for in that way they are ready to go on the planer for the first cut, which is over the bearing spots, and raised ¼-inch above the general level. After making the first cut, the casting is turned over, packed up roughly, and a good cut run over the face. "Packed up roughly" because there is no excuse for wasting time to "pack to 0.001" when the casting may spring a thirty-second after the skin is taken off the face.

Re-packing

Following the rough cut, the clamps are loosened and the job re-packed with care, because there will be no subsequent structural change of any amount since the cuts will be light and over a comparatively level surface of clean metal. The castings always spring up in the centre, which is about the meanest way they could go from the standpoint of the man who has to get a piece of paper or tin in under that casting to support its centre against spring and chatter. And when a metal shim is successfully located there is no guarantee that it will stay put.

There are four or six of these "inland" bearing spots besides an equal or greater number around the outer edge—the spots are arranged in line so there will be a minimum of planing required. A scheme has been devised to avoid packing up in the centre: this is, to plane the centre spots first, then according to the size of the casting to lower the tool a sixteenth or a thirty-second, and cut the outer spots. Now, when a plate is turned over after the under side is cut, it rests hard on the centre spots while the edges are up, but the latter are outside and so get-at-able that it takes only five minutes to put in tin or paper shims. From that point, the finishing takes the usual form of cutting with flat and spring tools and may be carried on rapidly because there is excellent support even though the casting is relatively thin and light.

The method of handling the castings, while it would not appeal to the efficiency expert, has proven to be all that could be desired. Probably for this particular shop, it is more efficient than an overhead track system or one of the various types of cranes. The castings are bought outside and delivered by motor truck, two or three at a time. For the standard sizes, the weights run from 700 lbs. to 1100 pounds.

Shop-made Trucks

Wooden trucks of skeleton design are made up of 2 x 3 maple with swivel casters on the four legs. The height of the trucks is the same as that of all the planers (which latter have been made alike). And this height is about the same as the motor truck body. This way there is very little lifting. The truckman is paid to deliver the castings in the shop and to carry them away crated from the shop. He is familiar with the shop facilities and does the loading and unloading with his own man unless he happens to be single handed, in which case he is loaned a boy or man for a few minutes. By placing a roller under the plate in his wagon and one on top of the shop truck that is to receive the plate, the latter is shifted very quickly. In fact, the change is made as quickly as a similar one to any other kind of handling device. Once on the truck, a boy can move the load to any part of the shop over the hard, smooth concrete floor.

These trucks are shop-made affairs, just for this one job. Besides the frame, there are half inch tie rods inserted top and bottom in both directions. Where the casters are fastened to the legs, a cast iron socket is used; this surrounds the post, extending up three inches, and makes a far more substantial construction than if the casters were fastened directly to the wood.

While a certain number of finished plates are kept on hand, the number shipped corresponds very nearly to the number received so that the necessity for some sort of live storage is evident —and this method is that of the trucks. The simple scheme of having the plates delivered flat side down makes it very easy to handle the plates on rollers, as well as delivers them the way the planer hands want them. Then after they are turned and finished on the flat side, they are shifted back on the trucks and there packed. The packing crates are standardized; the boards on top (the flat side) run across the plates, while those on the bottom run lengthwise—this latter makes the load as easy to put in the motor truck as it was to get out.

Hardening and Grinding Milling Cutters

Process of Hardening Equally Important As Quality of Steel—Care Should Be Taken in Heating—Grinding Wheels Must Be Kept Clean—Clearance Dependent Upon Material To Be Cut

By F. H. Sweet

IT IS NEEDLESS to say that the quality of steel used for the making of milling cutters is of great importance, yet the process of hardening is just as important, if not more so, than the quality of steel. Users of milling cutters will agree that a low grade of steel properly hardened and tempered will give better service than a high grade of steel poorly treated. But when both quality of steel and process of hardening and tempering are taken into consideration, a wonderful cutting wheel can be produced.

The methods of hardening, tempering and grinding milling cutters as set forth in this article may not be the best, but I have great confidence that anyone following the method will be quite successful and amply rewarded for the time spent in making the test.

A suitable place for hardening the cutters will be found in some rather dark corner in the shop. At any rate, the direct sunlight should be excluded from the room. The forge may be used for heating or, in case gas is handy, it is to be preferred. However, as many of the shops, especially the ones in the smaller places, have only the common forge for heating, I will consider the forge here.

Preparing the cutter for the hardening process is the first important step. In case it has blind holes or sharp angles, they should be protected with clay. Should there be a weak place which would be liable to crack in quenching, the better plan would be to protect it with asbestos. This asbestos will keep the part soft, allowing a greater expansion and contraction, and many times it saves a very valuable cutter from the junk pile.

Heat With Care

In heating the cutter, use every precaution to heat it slowly and evenly, or some part of it may be ruined before the heat has been well started. In case the heat has been applied slowly and evenly, a cutter may be heated even without serious damage, although the proper heat is much better. If the cutter is heated unevenly or overheated, there is danger of cracking it in quenching. Many times the teeth will crack and part company with the body of the cutter.

In case a mistake is made in heating, a very good plan is to remove the cutter from the fire and place it to one side. Cover it with finely burned ashes and allow it to cool very slowly. After this, the operation of heating may be repeated.

Large cutters must be handled differently from the small ones; that is, more care must be taken to get a fire that will accommodate the larger one in a uniform manner. Make the fire good and deep in the forge, with plenty of good, well-coked coal as a foundation, and bank the sides well up with fresh coal. Now make a bed in the live coals of the proper size to accommodate the cutter and place it flat and even in the coals, being careful that the air blast will strike evenly under the cutter.

Begin to heat slowly until a uniform red commences to show over the entire cutter, then place some slats or boards about ¾ to 1 inch thick under the cutter. Use the air blast lightly until a bed of live coals is again under the cutter. Turn the cutter again and place a fresh supply of pine slabs under it. The chances are, unless the cutter is very heavy, that a couple of applications of pine slabs will be sufficient, but in case more heat is necessary, continue to use the slabs, each time turning the cutter over. When the cutter has been heated evenly to about the desired heat, continue a little longer so that the heat may be on the rise at the time of quenching.

Remove the cutter from the fire and place in the brine bath, leaving it in the bath for about one minute, after which take it from the brine and put it into a bath of oil, allowing it to remain there until it is entirely cold. The hardening of the cutter is, without doubt, the most particular of any operation entering into the making of milling cutters.

The Right and Wrong Method

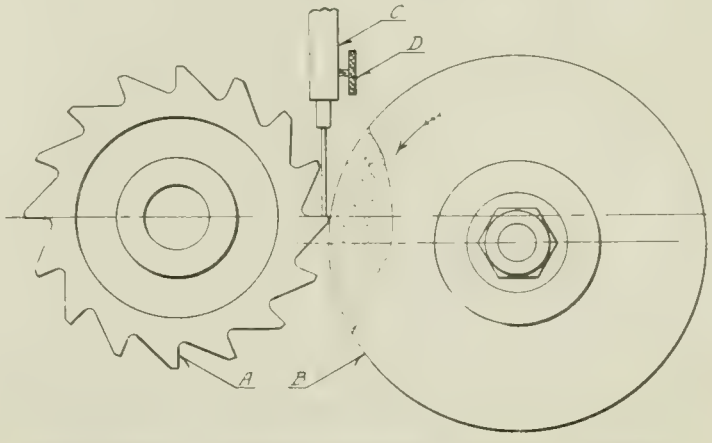
The plunging or quenching is a very simple operation, but there is a right and a wrong way of doing it. Should the cutter be a thin one, the best plan will be to dip it vertically, for the simple reason that if it were applied flat side down the lower side would naturally be cooled the faster and the cutter would have a tendency to cut or warp, so to speak. Although this might be to a very small extent, the cutter might be rendered absolutely useless, so far as answering the purpose for which it was made.

In case we are to dip or plunge a cutter with a long hole, the better plan is to dip it with the hole vertical, allowing the water to circulate freely in the hole. There are special cutters with large recesses, and these should be dipped with the recess up. If they were dipped with the recesses down, steam would be formed and prevent the water from coming in contact with the cutter. This might result in a crack or hard and soft spots in the region of the recesses.

One important rule to be remembered is to cool symmetrical parts simultaneously and let the water have free access to every part of the cutter as nearly at the same time as is possible. Should one prefer, the cutter may be cooled sufficiently so that no color will show at the cutting edge if the cutter is polished immediately.

The large cutters may be removed from the bath just as soon as the cutting teeth are hardened. In a very few minutes the heat in the body of the cutter begins to run out to the teeth, but just before it reaches the teeth the cutter should be again plunged for about a second. This may be repeated three or more times, according to the size of the cutters.

When at last they are cold, they should be put back into the fire and maintained for three or four minutes at a heat sufficient to show color—a very light straw—and let it cool in the air, not draft. The teeth should be as hard



THE AUTHORS SUGGESTION REGARDING GRINDING CUTTERS

as a new file, in fact, they should be hard enough to scratch glass.

One of the first considerations for sharpening milling cutters is the grinding wheel. The grinding wheel should be neither too coarse nor over fine. A coarse grade of wheel, sufficiently hard so that when in use the emery will not fly, is found to be the best suited for most classes of work and less liable to draw the temper of the milling cutter.

Keep Wheels Clean

The grinding wheel should be kept clean, as a wheel with a dirty or gummy surface will not cut well and will have a tendency to draw the temper from the cutting edge. A gummy, dirty wheel also has a tendency to cut and gouge, leaving a very irregular surface. There are a number of methods employed for cleaning the grinding wheels, but the methods which follow I have found to be very satisfactory.

In case the face of the wheel is gummy, dirty or irregular, the diamond truing tool will be found the most satisfactory, for it not only removes the dirt, but trues the face of the wheel as well.

Should the side of the wheel be dirty and irregular, a very good plan is to sprinkle coarse emery upon the surface plate and rub the surface of the wheel lightly. This will remove the dirt and gum from the wheel, leaving the sharp particles of emery projecting free to cut. In the event of the cutting wheel drawing the temper from the cutter after it is thoroughly cleaned, reduce the cut until the heating is stopped, even though it is necessary to make two or three cuts to get the cutting edge sharp.

In grinding milling cutters or reamers, it is better to plan to run the wheel the entire length of the cut and pass off at the end before setting the cutter for the second cut, as this will eliminate the danger of gouging or scoring the cutter at the extreme outer ends. Much care should be exercised in keeping all bearings and joints tight so that there will be no variation in grinding the different cutting edges of the milling cutter. Cutters should be kept sharp at all times, for a cutter that is kept sharpened will outwear one that is dull and drags, pushing rather than cutting the metal away.

When possible, or rather practicable, it is better to grind cutters with the emery wheel running onto the outer edge, as it secures a finer cutting edge on the tooth. The central axis of the grinding wheel, B, is slightly lower than that of the milling cutter, A. To make sure that the cutting edge will have a clearance and pass freely from one cut to the other is a matter of importance. This, as a matter of fact, can be controlled to a large extent by the adjustable guide shown at C, having a movable leg, E, held in position by locking nut D. By shortening leg E, the cutter may be revolved on its axis, giving more or less clearance, as desired.

POINTS BROUGHT OUT

That a low-grade steel properly hardened and tempered, will give better service than a high-grade steel poorly treated.

That direct sunlight should be excluded from the hardening room.

That weak parts should be protected with clay or asbestos, thus lessening the size of the scrap heap.

Heat cutters slowly and uniformly. It's another case of the more hurry the less speed.

That the piece can be ruined in quenching. Be sure to study the nature of the piece, for there is always a right and a wrong method.

Cool symmetrical parts simultaneously. Let the water have free access to all parts of the cutter at the same time if possible.

Amount of Clearance

The necessary amount of clearance must be decided by the material to be cut, especially in the grinding of reamers to be used on brass, which for free and easy cutting should have a clearance of five to ten degrees. Should we use a reamer on brass with a greater degree of clearance, it will be liable to chatter and leave a wall rough and pitted.

Steel and cast iron to be faced with the milling cutters should first have the scale removed and the cutters ground with the proper clearance. From about five to twelve degrees rake will be found best for materials of this kind. The clearance will vary from three to eight, any many times to even ten degrees, depending upon the hardness of the material cut.

Should there be a tendency to chatter, the cutting edge of the cutter should be treated with the oilstone until the chattering is stopped. Chattering is nothing but the cutting edges biting and letting go in rapid succession. There are times on special jobs of very broad work where it is necessary to grind the cutters so as to remove the rake entirely, allowing the cutter to drag in order to prevent chattering. In nearly every instance, especially on broad heavy work, place the cutter ahead of the centre, slightly exposing a larger cutting edge to the work.

When using multiple cutters, a better plan is to space them unevenly, giving the cutting the "staggering" effect, thus preventing chattering. The nearer the chuck or centre the cutter can be placed, the less liable it is to chatter and the smoother it seems to cut.

As a rule, the angle-clearance on all tools of this kind must be more than the spiral generated by feed at the smallest diameter of the cutting points plus a sufficient clearance to be really forced to the work below the cutter, which is very close to three degrees.

The angle-clearance may be varied by "stoning" to prevent chattering in case it is necessary, but it hardly will be necessary under ordinary circumstances.

RULES FOR HANDLING DIE BLOCKS

The following rules for the handling of die blocks are given by the Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa., in a recent publication entitled "Die Blocks":

1. Never harden a block unless the impression has been carefully polished. Rough impressions are the cause of many failures.

2. Never charge cold blocks into a hot furnace.

3. Never rush heating operations. Take plenty of time and save trouble.

4. Never quench a block that shows uneven heating. If properly "soaked," the color and temperature will be the same throughout.

5. Never allow a block to become dead cold in the bath.

6. Never postpone the drawing of a die block. Draw it immediately after hardening.

7. Drop-forging dies should never be stored in a cold, draughty place after hardening.

As the result of an examination by the American Bureau of Standards of a large number of specimens of the steel deposited in electrically arc-welded joints it is stated that this metal has mechanical properties like those of an inferior casting. In tension tests the metal showed low ductility, and all of the specimens examined—about seventy in all—showed evidence of unsoundness in their structure, tiny inclosed cavities, oxide inclusions, and lack of intimate union. The conclusions reached are that this unsoundness is a necesary consequence of the method of fusion as now practised, and that it is responsible for the deficiency in ductility of the joint metal. Both a "pure iron" electrode and a low carbon steel electrode were used, with practically equal results. The composition of the material changed in fusion by elimination of carbon and other elements. The use of slight protective coatings on the electrodes did not appear to affect the mechanical properties of the arc-fused metal.

The Swiss Government, which has been exploring for iron-ore deposits for several years, has made a real find in the Frick valley. According to a contemporary, some 15,000,000 tons have been estimated, with less than half of the deposit explored. A furnace plant is to be established with the State as part owner. Electrical smelting will be employed, with a saving, it is anticipated, of nearly three-fourths of the coke burnt in ordinary furnaces.

Have You Tried This Contest Yet? If not--- Do so Now

Below will be found twelve references to advertisements in this number. To the sender of the first correct set of answers to these we will forward one of these scales.
To win one is not difficult, and at the same time you will add to your store of knowledge. Read the details given below.

The scale is 6 in. long and is made from finest quality steel. One side is marked in 32nds, the other side in 64ths. A table of decimal equivalents is also stamped on one side, and a table of tap drill sizes on the reverse side. This scale is well worth securing.

What You Have to Do

We publish every week a number of interesting facts or statements selected from the advertising pages for that week. The selections for this issue are given below. Read these through, then turn to the advertising section and see if you can pick out the advertisements to which they refer. The work is interesting, it will train your powers of perception and of memory, it costs you nothing, it will make you better acquainted with the various lines of machinery and tools in the market, and with perseverance you are bound to win one of these useful scales as a prize.

Four contestants had correct lists for the Feb. 3rd issue and we had to resort to the elimination process as described in the Feb. 10th issue before a winner could be announced. Harold Baird, Windsor, N.S., was the lucky one, and Clarence Welsh, Port Hope, George Todd, Penetanguishene, and Wallace A. Powers were the second, third and fourth in place. The interest in this contest is keen, and we request that readers send their answers in as early as possible.

CONTEST FOR FEBRUARY 24TH ISSUE

Contestants are required to write us, stating to which advertisements we refer in this number.

1—Something that is easy to instal.
2—How to get away from leaky joints.
3—An emphatic statement.
4—Something that should not be lightly considered.
5—How to solve the temperature problem.
6—A reasonable request.
7—Three features of importance on a certain tool.
8—Something that means a serious loss if not watched.
9—A product said to develop maximum power.
10—Something new.
11—Something that obviates heavy freight charges.
12—How to obtain full capacity plant operation.

These are Correct Answers for List from February 3rd Issue:

1—Canadian Ingersoll Rand Co.
2—Heald Machine Co.
3—Dominion Rubber System.
4—Rockford Milling Machine Co.
5—E. C. Atkins & Co.
6—The Standard Optical Co.
7—Kearney & Trecker Co.
8—Photostat Corporation.
9—Modern Tool Co.
10—Oliver Machinery Co.
11—Fellows Gear Shaper Co.
12—The Acme Machinery Co.

Closing Date for This Contest is March 17th.

WELDING AND CUTTING

Hints on Oxy-Acetylene Welding and Cutting

Preparation for Welding—Different Styles of Joints—Examples of Work Performed—Preheating, Reheating and Annealing—Welding Rods Used.

A BOOKLET recently issued by the Oxweld Acetylene Co., Newark, N.J., embodies some helpful instructions in the art of welding which, as they will doubtless prove of interest to our readers, we have secured the privilege of reproducing. The first subjects to be dealt with are proper preparation for welding, reheating, preheating, and annealing and manipulation of blowpipe.

The operator should remember that any job to be welded must be properly prepared, cleaned, lined up, etc., before the blowpipe is lighted. Metals of ⅛ in. in thickness or less are usually butt welded without bevelling, while in welding metal parts more than ⅛ inch in thickness the entire thickness of each side should be bevelled at an angle to give a groove between the edges of from 60 to 90 degrees. Bevelling insures penetration of the weld entirely through the metal. This is especially necessary in heavy sections. When the metal is more than ¾ inch thick and it is possible to weld from both sides it is sometimes advisable to bevel as illustrated by Fig. 6.

For work exceeding ¾ inch in thickness, the bevelling operation, in the case of steel, can be performed by means of the oxy-acetylene cutting blowpipe. On thinner sections, the bevelling can be performed by grinding, or with a hammer and chisel. On the thinnest sections where bevelling is necessary, use a file.

In construction work, on extremely thin sheet metal sections the edges of the parts to be welded should be flanged as shown at Fig. 4. When this is done, no filling material need be used, the metal in the flange serving this purpose. Fig. 5 shows the appearance of a weld made on thin sheets, flanged before welding. Fig. 7 shows a type of clamp that can be used to advantage on thin metal sheets flanged for welding. It can be operated by a helper, who grips the metal a few inches ahead of the weld and moves the clamp when the welder comes up to him. On long seams a number of these clamps can be used, being held in position by the locking ring which is shown around the handle.

The lap weld shown under Fig. 6 has some disadvantages and should only be attempted when butt welding or flange welding is impossible. The weld does not penetrate the total overlap of the parts and is therefore of uncertain strength.

In all welding operations, the parts to be welded should be set in proper alignment before the flame is applied. Too often, operators fail to take enough time at the start to properly line up the parts to be welded. The result is that the work is sometimes found to be out of alignment and the part rendered useless, no matter how good a weld has been made.

Fig. 7.—Method of holding flanged sheets in position for welding.

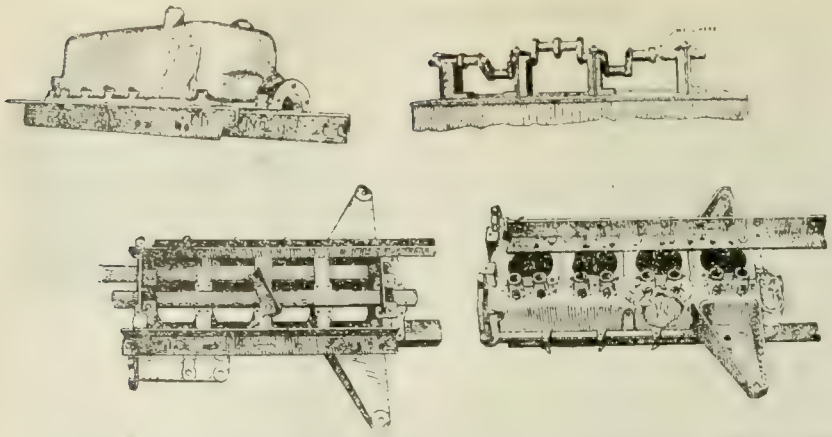
It is always advisable to have on hand a good supply of different size clamps, "V" blocks and mandrels. These are always useful in setting up various jobs, as shown at Figs. 8 to 11. The inexperienced operator will find it a big help to build a form of fire clay as a support for the broken sections while repairing thin castings. This holds the parts true and also assists in the control of the molten metal.

Whenever it is necessary to weld in a patch, a new piece of the same metal should be cut to the proper size and shape, the edges of both parts bevelled, and the patch held in place temporarily by "tacking," that is, welding at several spots some distance apart along the line to be welded. To hold a large patch in position while being "tacked," it may sometimes be necessary to drill a small hole in the center of the patch into which a length of rod can be inserted, and by which the patch may be handled. This hole may afterward be plugged and welded up. Small patches, to be placed in difficult positions, may be conveniently handled by simply welding a welding rod to the center of the patch. This may later be melted off. All metal should be thoroughly free from grease, oil, dirt, rust and scale in the neighborhood of the weld before the welding flame is applied.

Expansion and Contraction

In every case of welding, internal strains are inevitably set up due to expansion when heating and contraction when cooling. When parts being welded form part of a structure and are not free to move during the welding process, the strains produced may cause the metal to crack. This is especially true of cast iron. If the cooling after welding is rapid or irregular, the tendency to crack will be greatly increased. Whenever local strains due to expansion or contraction exceed the strength of the metal a fracture must occur. To relieve internal expansion and contraction strains, caused by the intense heat of the welding flame and subsequent rapid cooling, it is desirable to preheat the whole piece before welding, sometimes heat it during welding, and then to reheat it after the welding is completed. In the case of a

Fig. 4. Upper left. This type butt joint is used for sheets up to ⅛" thick.
Fig. 5. Lower left.—Flange joint for thin sheets after welding.
Upper Centre—Bevel used on plates above ⅛" thick.
Lower Center.—Flange joint for thin sheets before welding.
Fig. 6 Upper right. Bevel and weld for very heavy sections.
Lower Right. - Lap joint that should not be used.



Figs. 8 to 11 inclusive. Upper left, shows lower section of aluminum crank case clamped to angle iron to insure alignment. Patch is shown ready for welding. The other views also illustrate methods of ensuring proper alignment.

restrained section of a cast iron part, this treatment is imperative—the heating should be carried on slowly and the work kept as free from air draughts as possible. This treatment is not always essential for steel but can never be anything but beneficial.

Preheating, Reheating and Annealing

In order to economize in the consumption of acetylene and oxygen it is often desirable to heat the work to be welded as much as possible before the welding flame is applied. In the case of small castings the preheating of the whole piece is generally essential, not merely from an economical point of view, but in order to bring it to a uniform heat and thus insure a uniform contraction while cooling is taking place after the weld is made. In some cases to obtain this result it is necessary after preheating and welding to reheat the piece in order to equalize the temperature (which is naturally highest along the line of weld). This insures uniform contraction and freedom from internal strain.

Welds in steel or iron plates where preheating is not necessary will always be improved if annealing is done along the line of weld. For these operations various sources of heat can be employed. Illuminating gas used in conjunction with air can often be used to advantage. A simple gas torch to do this can be easily constructed from ordinary gas pipe, as shown in Fig. 12. The lower pipe supplies the illuminating gas and

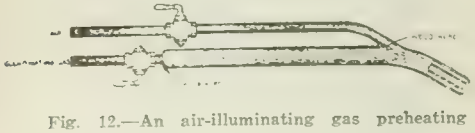


Fig. 12.—An air-illuminating gas preheating torch.

the upper pipe supplies the air, delivered at about two pounds pressure. For the air supply a small blower is quite suitable and inexpensive.

On many occasions oil can be used as a source of auxiliary heat with very good results, and in a wide range of conditions is probably the most economical one to employ.

A coke or charcoal fire is excellent for preheating if the size of the casting renders heating by a torch impractical. Charcoal is better than coke, since it gives a clean fire of about the right temperature and leaves little or no ash. Once started, charcoal burns readily with a small draft. If coke is used, care must be taken to see that the work is not allowed to become overheated and burned. An ordinary blacksmith's forge may be used for heating parts when no other method is available, but great care must be taken to see that the work is not burned, due to overheating on one side.

Preheating preferably should be done in a brick furnace. A picture of a fire-

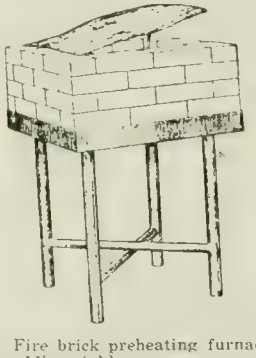


Fig. 14. Fire brick preheating furnace mounted on small welding table.

brick furnace mounted on a welding table is shown in Fig. 14. The table is built up of gas pipe and sheet metal, welded where necessary. The top is covered with fire brick. Loose fire bricks are used to form the sides of the furnace; these may be arranged in any form to suit the particular job. The top of the furnace consists of a loose piece of sheet iron. A hole for the preheating torch may be left in the side. After the casting has been brought to a dull red heat, the cover is removed and the weld made. After welding, the casting again should be brought to a dull red heat all over and allowed to cool gradually. After this final reheating, all holes in the furnace should be plugged up with fire clay or asbestos to keep the heat in. If it is impossible to do this, then it is advisable to cover the casting entirely with lime, sand or charcoal to keep the air away from it.

Where conditions justify it, a small muffle furnace may be employed. The part being welded is placed on a small car which operates on a track leading into the furnace. Then, if the casting cools before the weld is finished, it may be shoved back into the furnace and brought to the proper temperature before the weld is completed. Something of this kind is very convenient where a number of castings of approximately the same size and shape are to be repaired. It is advisable to provide the operator with a pair of large gauntlets, preferably of asbestos, or other protective material, to protect his hands and wrists from the heat.

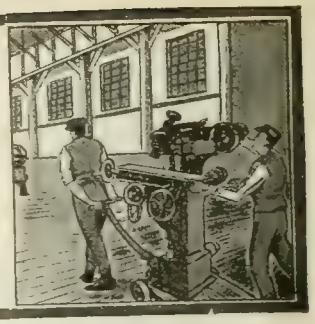
Welding Rods

The gap, or crack, that exists between two pieces prepared for welding requires that some additional metal be supplied to fill it up. For this purpose rods or wires known as welding rods of various styles are employed. It will be appreciated that the strength and nature of the welded joint will depend to a great extent on the nature of the filling rod. In order to obtain a joint that will be the same as the metal of the parts being welded it is of course necessary that the added metal after the welding is completed be of the same percentage composition. In order to obtain this ideal result it is often necessary that the rod before it is melted into the gap or crack, contain some excess of the substances (foreign to the pure metal) which give to the sections of the metal part to be joined their particular characteristics of hardness, ductility, or high tensile strength. The necessity at times for adding an additional quantity of this particular quality giving substance is due to the fact that a portion of this substance may be burned out (or volatilized) during the welding. As an example take the case of 0.20 per cent. (20 point) carbon steel—if it was desired to have a welded joint with the carbon content the same, it would probably be best to use a rod that had 0.35 per cent. (35 point) carbon content, and then a good deal would depend on the speed at which the work was performed and the skill of the operator.

Fortunately such ideal results are not often necessary in practice and the employment of good rods supplied by firms of repute will give joints that are of such a nature that they will stand the stress and wear of use. For some classes of welding work it is necessary that the rod contain some foreign substance that is not in the metal to be welded in appreciable quantities, in order to help counteract the tendency to oxidize or assist in making the molten metal flow evenly. As an example, take the case of rod employed for welding grey cast iron. This must containe 3 to 4 per cent. of silicon to act as a deoxidizer and also assist in the prevention of formation of white iron. In most cases these difficulties are overcome by the use of a flux.

To be continued

DEVELOPMENTS IN SHOP EQUIPMENT



MOTOR DRIVEN BREAK LATHE

The Canada Machinery Corporation, Ltd., Galt, Ont., recently shipped a rather interesting 74 in. x 10 ft. motor driven break lathe to China. This machine is to be used in one of the large Chinese railroad shops and the illustration shows the general appearance.

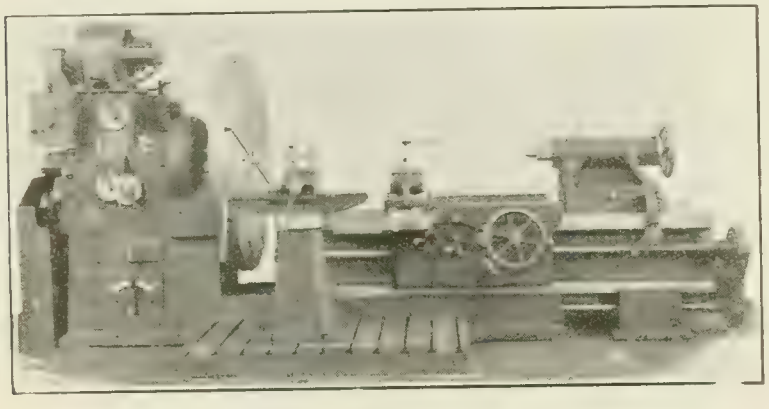
Probably the most interesting part of this lathe is the head which is their standard 27 speed design. 18 of these speeds are obtained through the spindle and 9 through internal gear on the face plate, thus giving a large range of speeds suitable for any class of work. The speed changes are all readily obtained by levers located on the head of machine, the motor being mounted directly on top and driving to head by means of steel and rawhide gears. A friction clutch is mounted in this gearing for convenience in starting and stopping. Due to an interlocking arrangement of the gear changes it is impossible for any two conflicting combination of gears to be meshed together with consequent damage to the machine.

The bed is deep and braced with cross ribs of box section, being provided with three large inverted V's, and while the tailstock rests on one V and one flat surface, the saddle bears on two V's and also on the flat surface. The bed moves on the base by means of a rack and pinion which is operated by a wrench at rear of machine, and is clamped in place by bolts, which fit the tee slots in the base. It is also supported by a box leg in order to eliminate any strain from overhang when at its extreme length.

The base is of massive construction and ample weight to support the bed and headstock. It is provided with a planed slot fitting the rack in the bed which acts as a tongue and insures alignment in any position. The extended portion of the base is slotted in order that the pedestal tool post may be placed in any position.

The spindle is turned from special high carbon steel and has a hole bored from the solid through its entire length. On the nose is milled an Acme thread to receive face plates. The gears in the apron are steel, and in order to facilitate the movement of the saddle the hand wheel is not geared directly to the rack in the bed, but indirectly through a reducing intermediate gear. The rack pinion is drawn out of mesh by a knob handle on the end of the pinion stud, when the machine is used for screw cutting. In order to obviate the necessity of reversing the lathe when screw cutting, a thread chasing dial for indicating the correct point for engaging the nut is provided on the carriage.

A compound tool rest on the saddle is provided, as well as a compound pillar rest with English tool post mounted on the extended base. The upper portion of this tool post is pivoted and is graduated so that it may be swung round to any angle. It is subject to variable longitudinal feeding by means of an overhead rocking shaft operated from a lever on the headstock. The tailstock is clamped to the bed by four bolts and is also braced by a pawl engaging in a rack cast solid in the bed in order to relieve the strain when doing heavy work. It may be set over to turn tapers, the base being graduated for this purpose. The lathe weighs approximately 30,000 lbs.



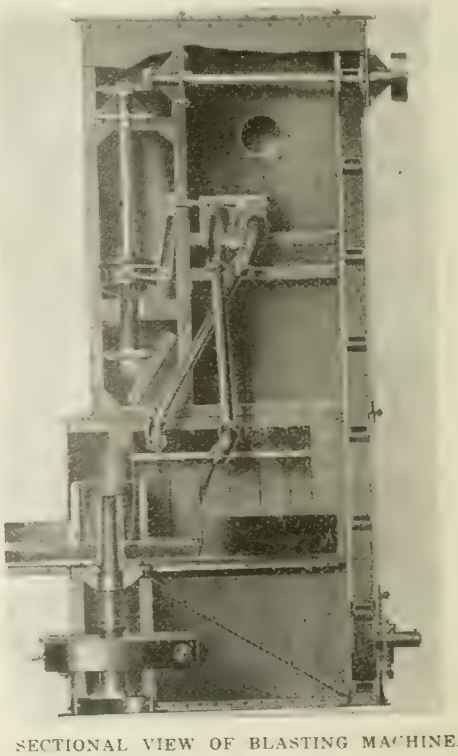
GENERAL VIEW OF THE LATHE

SAND BLASTING MACHINES

The Pangborn Corporation, Hagerstown, Md., have placed on the market a line of rotary automatic table sand blasting machines. These machines are made in five sizes, and have three different systems of blasting action.

For the larger character of work the direct pressure system is used with the blasting action supplied by a direct pressure hose blast and equipped with elevator and separator, using both mechanical and exhaust means for reclamation and separation of the abrasive. The reclaimed abrasive is accumulated in storage bins from which the hose blast is instantly refilled through a quick acting valve, that makes the operation practically continuous. This machine is made in two sizes, with table 70 inches and 90 inches in diameter, with clearance of 15 inches between the table top and nozzles. Oscillating nozzles (see Fig. 1) cover the entire surface of the blasting zone which is entirely enclosed.

For work less difficult to clean, or where the intensive action of the direct pressure is unnecessary the gravity feed type of machine is equally efficient and permits of an entirely self-contained machine. Mechanical and exhaust action is



SECTIONAL VIEW OF BLASTING MACHINE.

used for reclamation and handling of the abrasive which is fed by gravity in a continuous cycle to the nozzles, where the full force of the air is exerted to the propulsion of the abrasive. This machine, though made in but one size with table diameter of 84 inches, has an adjustment of the nozzle arms that permits a clearance of 10 inches or 15 inches between the table top and the nozzles, making it applicable to the widest range of work. Like the direct pressure the blasting action is entirely confined and movement of the nozzles covers every portion of the work within the closed zone.

For the cleaning of lighter work and requirements of refinishing, etc., a self-contained suction feed type is made.

The used abrasive is reclaimed through screens and the handling is without elevator use. The cleaned abrasive is carried continuously by suction or syphon to the nozzles.

This table is made in two sizes, a 42-inch diameter table with one nozzle with vertical adjustment allowing any distance from 5 inches to 12 inches between the table top and the nozzles.

The larger size of these machines has a table diameter of 70 inches with clearance of 12 inches between the nozzles and table top allowing for reasonably large work or a large quantity of small pieces. Like the other models the blasting action is entirely confined and the nozzle movement covers the full area of the blasting chamber.

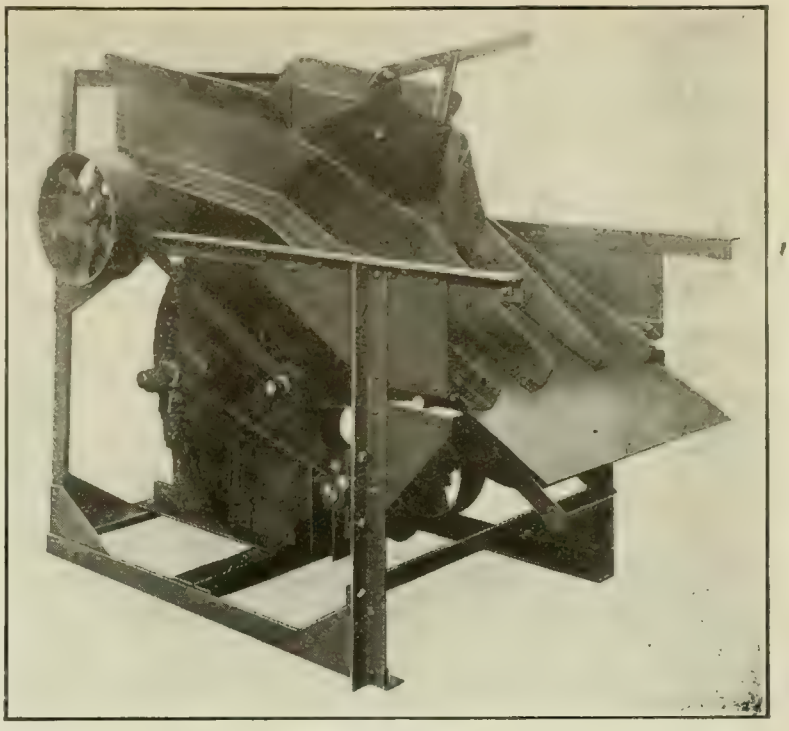
PNEUMATIC CHIP SEPARATOR

The pneumatic chip separator shown in the accompanying illustration has been placed on the market by the Ideal Concrete Machinery Co., Colerain Ave., Cincinnati, Ohio, for use in separating chips from screw machine products and work of a similar nature. It is claimed that by the use of this machine one operator can handle as much work as three men using riddles, or as much as six men picking by hand.

The work and chips are placed in the hopper of the separator as they come from the machines. The hopper and the inclined slide which is attached to it have a compound vibratory motion. When the gate at the front of the hopper is opened, the vibratory motion causes the work and chips to slide down over the inclined slide. A properly located opening in the slide permits the work to drop into a tote box or pan, while the chips are passed over the opening by means of an air draft from the fan so that they fall off the end of the slide.

The distinctive feature in the operation of this machine is as follows: The compound vibratory motion which spreads out the work and chips as they come down the slide permits a light air draft from the fan to float the chips over an opening in the slide through which the work drops; this method of separating the chips requires a much lighter air draft than would be needed if the chips were blown up into the air, and at the same time effects a satisfactory separation of chips from small as well as large work. In addition, the work does not at any time pass through enclosed passages, a feature which renders it practically impossible to clog the machine by overloading.

The frame of the machine is constructed of angle iron, hot-riveted, and reinforced at the corners with heavy gusset plates. The bearings are lubricated by grease cups and sight-feed oil-cups.



GENERAL VIEW OF THE CHIP SEPARATOR.

CYLINDER-GRINDING MACHINE

A grinding machine, constructed on the knee-type design, and especially adapted for general repair work, has recently been placed on the market by the Heald Machine Company, of Worcester, Mass. This machine is primarily intended for repair work on automobile engines but its construction makes it highly suitable for all-round work. The size of the table is sufficient to provide plenty of range for large work without excessive overhang. The table travel is adjustable and automatically reversed. The wheel spindle is hardened and ground with solid taper bronze bearing at the front end and self-aligning ball bearing at the rear. Interchangeable pulleys are provided for varying the speed of the wheel spindle.

PISTON-RING GRINDING MACHINE

An attachment for the automatic grinding of piston rings, for use on their standard rotary table machines, has been brought out by the Persons-Arter Machine Company, of Worcester, Mass. The piston rings are fed on and off the machine automatically, the device being operated by compressed air supplied from the ordinary air lines of the shop. The device consists of a plate containing six recesses for holding the rings, and these are located intermittently beneath the grinding wheel, and while in this position are given the necessary motion for the grinding of the ring. The air cylinder for operating the attachment is located beneath the work table.

SPRING THREADING TOOL

A new design of spring threading tool has been placed on the market by the Ready Tool Company, of Bridgeport, Conn. The tool holder is of the goose neck type, and the cutter is made of high-speed steel and placed in the holder at an angle of 15 degrees with the vertical, the sides of the tool being ground to provide for the cutting of a 60-degree thread; only the top surface of the tool is ground when sharpening. Teeth are provided both in the tool bit and in the head of the clamping dog. Adjustment of tool resistance is provided for by the addition of a flat spring in the goose neck of the tool holder. The tool has a righ hand off-set and is made of ½ by 1-inch stock and 7 inches long.

The H. Mueller Mfg. Co., Ltd., Sarnia, Ont., are contemplating the erection of an iron foundry.

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PRINCIPAL CONTENTS

The Use of Ball Bearings

DID you ever watch a lot of huskies heaving and tugging at a heavy load? There's a tremendous amount of energy expended in the stone-age method.

Then some chap takes a walk into the shop and brings out a couple of pipes for rollers. The rest is easy.

The rollers eliminate a good share of the friction, and the more this is done the greater the ease with which the load will move.

And yet there are plants that continue to run their power transmission largely on the idea of the plank on the road. The application of the principle of ball-bearings is so well established that it does not require argument.

The first article in this issue of Canadian Machinery deals with the usefulness of ball-bearings to industry, showing the development of the idea and the extent to which it has been applied to mechanical work. Further instalments will also appear and then again on March 17th the same matter will be taken up from another point, viz., "Direct Application of Ball Bearings to Various Machine Tools."

Shop executives would be well advised to file this material away for future reference. It may suggest some of your own problems and show you very definitely where ball-bearing installations will be your best way out.

The Buyer in Control Now

THE buyer is in possession of the market now and he knows it. The good salesman is not going to object to this condition as long as the buyer is inclined to play the game square. The average salesman is keen for business and is ready to get down to brass tacks with any man who has business to place.

One dealer was giving his opinion of a certain purchasing agent this week and added, "He is certainly a hard buyer and when he gets his prices just now there is not much left in it for the dealer. But we know he means business when he asks for a quotation. We don't mind that sort of a man, because he is out to place some business in the market and it is his duty to his firm to get the best price he can. But we all know he is not just asking for prices to see how things stand. He buys hard, carefully, keenly—whatever you care to call it—but the big fact is that he buys and does not run away out of the market after getting the whole trade to give him quotations."

It is much better to study the market closely and then buy, than to simply stand on one side and wait until the whole market has adjusted itself to your liking.

Standards of Practice

CANADIAN MACHINERY is a member of the Canadian National Newspapers' and Periodicals' Association. That bare announcement may mean little in itself, but readers and advertisers are entitled to know what this Association stands for in its practices. It is entirely for the benefit of these two, particularly the readers, that the following standards of practice have been formulated:

1. To consider first the interests of the subscriber.
2. To work for truth and honesty in all departments.
3. To eliminate, in so far as possible, their personal opinions from their news columns, but be leaders in thought in their editorial columns, and make their criticisms constructive.
4. To refuse to publish puffs, free reading notices, or paid write-ups, to keep their reading columns independent of advertising considerations, and to measure all news by the standard "Is it real news?"
5. To decline any advertisement which has a tendency to mislead, or which does not conform to business integrity.
6. To solicit subscriptions and advertising solely upon the merits of the publication.
7. To supply advertisers with full information regarding character and extent of circulation, including detailed circulation statements, subject to proper authentic verification.
8. To co-operate with all organizations and individuals engaged in creative advertising work.
9. To avoid unfair competition.
10. To determine what is the highest and largest function in the field which they serve, and then to strive, in every legitimate way, to promote that function.

We ask the assistance of readers and advertisers in living up to these standards. This paper seeks to serve its field well and is at all times open to suggestions as to how this can best be done.

—From L. P. Miller, Russellville, Tennessee.
A RUSH ORDER

Gradual Improvement Has Been Noticed

FOR several weeks views have been appearing on this page tending to show that there is a gradual improvement in conditions. There has been no attempt made to exaggerate this improvement, neither has there been any move to cut out references that tended to show the conditions were not any more favorable.

There is a growing willingness on the part of manufacturers to give expression to their views on these matters and to pass along any helpful information they may possess.

"The improving condition is not such that it enables us to market cannot be said to have made much progress when compared to a week ago, although it is pretty hard to take it by weeks. But some of the firms were ready to admit that they had done a fairly good week's trading. Others saw improvement in the number of inquiries they had been receiving. Others had releases on orders that had been held up for some time. Not a great deal in any one place, but put together, quite a nice little showing in the aggregate.

Some machine tool dealers were interested in installations they had just completed in shops which had taken advantage of the dull season to improve their method of production. These plants are in good shape to go ahead now and they will be better able to produce than ever before.

Better Than a Month Ago

Canadian Machinery asked Dominion Forge & Stamping Co., Ltd., at Walkerville, if there was anything that had come under their notice that would indicate an improvement in conditions, and B. W. Vallat, the president, has replied that conditions are better now than they were and he looks for the improvement to be continued. Mr. Vallat adds that "We want to do our bit in furnishing anything along this line that will be of help to you."

"In our own business," he says, "We are pleased to state that things look very much better than they did a month ago. We believe that things have taken a decided turn for the better and I believe this applies to the entire district.

"We feel especially encouraged over the fact that it is possible to figure our work on a more sound basis than we were ever able to do before. Raw materials are more stable and we can get deliveries within a reasonable time. Labor is more efficient and is giving much better results, so that it makes a very much more definite basis for figuring out our work for the present and future.

"To my mind if there is any one thing more than other that would encourage manufacturers at this time it would be an announcement on the Excess Profits Tax, which would tend to either greatly reduce or abolish it altogether for this year.

"If any manufacturer is fortunate enough to make enough profits off of this year's business to go into the excess class he certainly is entitled to keep this money if he is going to stay in business and recover from this depression and the losses to which he has been subjected.

"The manufacturers have borne this burden since 1914 and if there was ever a year that they need a breathing spell it is this one. I have faith that our able representatives in Ottawa will be broad enough and far-sighted enough to make provision for this contingency."

Have Seen the Worst of It

L. W. Smith, manager of the Greenfield Tap & Die Corporation, Galt, believes, as many other business executives do, that we have touched bottom in a good many lines and from now on it will be a case of hard work and up the hill to normal.

Speaking to Canadian Machinery, Mr. Smith states:

"It is our feeling that the worst has been reached, and that there is a slight improvement in the general condition, that is in regard to the number of orders that we are receiving, and shipping slightly more than we were during November and December.

The improving condition is not such that it enables us to take on more employment as stocks have been brought up to a maximum and it will be necessary for us, as small tool manufacturers, to work on this stock until production orders in quantities are being received.

"I find that some of the factories in the automobile line, are putting on more help, and I am advised by some that in other month they will be in the market for production tools."

The Stock Order Heard Of

The stock order, that more or less reliable evidence of return to normal business conditions, is again making a voice in the land.

From various sources comes reports of this very encouraging turn of affairs.

"We are more than holding our own," said a Niagara district manufacturer to Canadian Machinery on Friday last. "Not only is there a good undercurrent of enquiry, but yesterday one of our oldest dealers called and placed a very nice stock order, payable in 30 days."

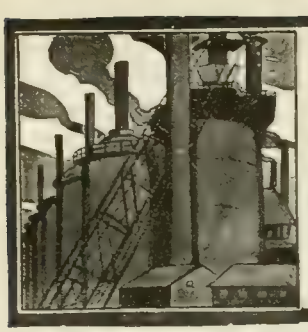
"Yes, there has been a marked improvement during the past few weeks," said a Western Ontario manufacturer of small tools. "Enquiries are good, nice business is coming in by mail and stock orders are beginning to make their appearance."

Business Morality Ebbs

"THE most painful thing about the difficult business situation which we have just been passing through," said Herbert K. Twitchell, President of the Chemical National Bank, "is the widespread slump in business morality. The war and the business situation that followed the war seem to have left the human race on a lower ethical level than it was before. This is not only true in Europe, in South America and in other parts of the world, but it is, unfortunately, true in America.

"American business men and bankers have been rather fond of pointing with pride to the high standard of business ethics in this country, and there is no doubt that this standard has, until lately, been very high, taking the business world as a whole. But the revelations of the last few months make it necessary for us to revise our good opinion of ourselves as a class.

"Men who a few years ago would not have dreamed of repudiating a contract, or trying to wiggle out of a bad bargain by subterfuges or resorts to technicalities, are doing these things today almost unblushingly. Cancellations of orders given and accepted in good faith are made on the slightest excuse or no excuse at all. Corporations, firms and individuals whose business honor has heretofore been unsmirched have weakened under the strain rather than do what every honest man does—take the loss and stand the consequences. Bankers see every day new evidences of such weakening of the moral fibre of concerns that have long enjoyed the respect and confidence of the business world."



MARKET DEVELOPMENTS

Tool Builders are in Session This Week

Some Announcement May Come, Following the Cleveland Meeting—Steel Prices are Being Trimmed in Order to Get Sales —Scrap Metal Market Dead, and Very Few Sales

THERE has been no continuation of the movement that seemed to be getting under way a few days ago toward lower prices in certain lines of machine tools and steel goods. The machine tool builders of United States are gathering in Cleveland this week and there is no doubt the question will be gone into there. A number of these plants are making machines for stock now and they have not much disposition to go ahead doing this, as the tools they are turning out now are high cost.

The steel market belongs to the buyer just now and he is taking advantage of the situation and buying more to his liking than he has been able to do for a good many months past. Anything that looks like a fair tonnage is pretty well carted around before the placing takes place and as a result there are departures more or less marked from quoted prices. The fact that little money is made on many of these sales is set over against the pleasing reality that it allows the warehouses to liquidate their stock and get in shape to buy to the best advantage whenever the turn in the market may come.

Machine tool dealers have a number of inquiries and they are making some fair sales. Some plants have taken advantage of the slack season to improve their method of production. The automobile shops show a slight improvement in the operation schedules and have hopes of maintaining this. Shops having contracts to make auto parts are getting release instructions on these and more employment is the result.

The scrap metal market remains as it has been for weeks past, viz., as near defunct as it can get. There is such a tremendous surplus of copper on the U.S. market that it may be some time before there is a recovery in price. Buyers cannot afford to sell what stock they have, neither can they take chances on buying, so in that atmosphere business hangs suspended.

PITTSBURGH MARKET SHOWS THAT BARS ARE BEING SOLD AT TWO CENTS

Special to CANADIAN MACHINERY.

PITTSBURGH, Feb. 24.—Enough time has now elapsed since the Midvale Steel & Ordnance Company began quoting prices below the Industrial Board and Steel Corporation schedule to make some appraisal of the situation. This is that Midvale and a few other independent steel producers are actively soliciting business at reductions of a few dollars a ton on most of the leading products, that practically all the other independents are willing to sell at reduced prices, provided the orders offered are large enough to make this worth while, and that the United States Steel Corporation is standing rigidly by the prices it has maintained since the Industrial Board adjustment of March 21, 1919.

As to the volume of business booked at the reduced prices, that is very small. It seems clear that practically no business was produced by the price cutting, the orders placed being chiefly or wholly orders that would have been placed in any event, orders that could not be held back because the need was pressing. As to the Steel Corporation, prior to the break it was booking rather a fair volume of new business, considering the general dullness. In both December and January the bookings were not far below 50 per cent. of capacity. The volume of new business given the Steel Corporation has now diminished very considerably. A more important effect upon the Steel Corporation is a large decrease in the volume of specifications on old contracts being filed. This is, of course, perfectly natural. Many customers of the corporation were taking shipments on their old contracts at a greater rate than was requisite to take care of current consumption, so that stocks were piling up, and when it was made clear that the contract prices could be shaded the customers naturally curtailed their specifications.

Extent of Cuts

The extent of the price cutting may be shown approximately by setting down the lowest prices done or quoted thus far by any independent, together with the Industrial Board prices to which the Steel Corporation strictly adheres, and which some of the independents are nominally quoting, until they are offered orders sufficiently attractive to justify cutting: Bars, 2 to 2.35 cents; shapes, 2.20 to 2.45 cents; plates, 2.25 to 2.65 cents; hoops, 2.85 to 3.05 cents; blue annealed sheets, 3.20 to 3.55 cents; black sheets, 4.15 to 4.35 cents; galvanized sheets, 5.35 to 5.70 cents; plain wire, 3 to 3.25 cents; wire nails, $3.10 to $3.25.

In standard steel pipe there is little if any shading, the standard price being a basing discount of 57½ per cent., but there are various price irregularities in specialties in tubular goods. In tin plate it seems clear that there is absolutely no shading by any mills on orders for actual production from the standard price of $7 per base box, 100-pound, but for quite a while past there have been offerings at second hand from stocks at deep cuts. At first these were chiefly by New York export houses, who had bought tin plate for export and did not complete the transaction, but lately there have been offerings by some domestic consumers.

Attitude of Independents

It being quite clear that the volume of steel business secured by the price cutting has not justified the making of

these reductions, for with the high costs ruling, partly due to the reckless manner in which independents operated when they were securing very high prices, and partly due to the light operation at present, there was not much room for cutting, the question arises, why did the independents start to cut prices? There are only two possible answers, that the independents made a mistake and that they did not make a mistake. They might have made a mistake by thinking that a reasonable amount of business could be gathered up by cutting prices, sufficient to give something like a fair operation and thus justify selling at close prices, or even at an apparent loss, by comparison with previous costs, because by economizing during the operation they could pare their costs. Such a result has not come. The amount of business secured is plainly not worth while.

If the independents did not make a mistake, then they expected what has occurred. What has occurred is that they secured very little business, and that the business of the United States Steel Corporation is greatly reduced. The corporation operated at about 92 per cent. in November and December and at an average of about 90 per cent. in January. Its operations were certain to taper off, but probably at no great rate. Now, however, the corporation's operations were at only about 80 per cent. last week and they are at less than that this week, with a prospect that in a very few weeks they will be quite low, under 50 per cent. and perhaps down to 30 or 40 per cent. The corporation's new business and specifications against old contracts have both fallen off, and a good many customers are probably instructing it to delay shipment on some of the material already specified.

This decline in Steel Corporation business is attributable in large part to the price cutting. There may be an advantage in that to the independents, on the theory that whatever steel the corporation makes is irretrievably lost to the independents, whereas by mixing things up the independents may secure a sort of redistribution. This is not theory, but the actual statement, made privately, of some of the independents.

Then there is the matter of wages. The independents have been wanting to reduce wages, and some of them did as long ago as last December, while others have only lately reduced, the Youngstown mills making reductions of about 20 per cent. last week, while the Steel Corporation has not reduced wages. The independents feel that if the corporation has to cut prices it will also reduce wages. Some of the independents did not take kindly to all the wage advances the corporation made during the war, and there was some feeling on the subject in the latter part of 1919, when the independents were disposed to advance prices. The attitude of the Steel Corporation at that time seems to have been "If you advance prices you will have to advance wages—why not advance wages first?" What occurred, however, was that the independents advanced prices and then the corporation advanced wages without advancing prices, the independents then having to advance wages also.

POINTS IN WEEK'S MARKETING NOTES

Only one or two odd price changes were noticed this week in the machinery market. It is felt that some announcement may be made following the meeting of the Machine Tool Builders in Cleveland this week.

—

Some of the automobile shops are beginning to operate at a fair rate and orders are being released to firms that had contracts held up on the making of auto parts.

—

The steel market distinctly belongs to the buyer at the present time, and there is a decided tendency on his part to take full advantage of the situation, with the result that prices are being cut pretty close in this district.

—

Merchant bar mill material is quoted at 4½ cents a pound in Toronto, while Montreal puts the price this week at 4¼.

—

United States machine tool builders are not inclined to go ahead building more machines for stock, and some of them are considering further curtailing their operations.

—

There is no improvement whatever on the scrap metal market. The yards are not buying and inquiries coming in are very meagre. The fact that prices are at a very low ebb is not having any effect on increased buying.

—

The record of sales in U.S. pig iron market brings out the fact that $25 is going to be more and more recognized as the market price, and sales are being made in several places at that figure.

—

Operations of the Steel Corporation are said to be below the 80 per cent. mark now, with the prospect that in a few weeks they will be well down towards the 50 per cent. mark.

—

It has been stated by Engineer F. A. Gaby, of the Hydro Commission, that if work progressed at the present rate on the Chippawa Canal power should be ready for delivery about Sept. 1 of this year.

As the market is extremely quiet as to actual developments, the tactical position and aspirations of the producers seem to be the important feature, as giving a line on what may be expected in the future.

Pig Iron

The first sales of basic pig iron of any consequence this year have just occurred, developing a new low price, $25, valley, or a sharp decline, as on January 1 the market declined from $33 to $30 by furnaces voluntarily quoting the lower price. There was no record of any sales of consequence until the $25 sales just made, which included at least one lot of 1,000 tons. Bessemer is now priced at $27, valley, with reports that a few carloads have been sold at this figure. Foundry remains quotable at $28, valley, with an occasional carload going. On any sizable lot these prices would probably be shaded. The prices are below actual cost, based on recent records, but costs will have to come down. The question just now seems to be whether pig iron prices are going to dictate coke and ore prices, or coke and ore prices are going to dictate pig iron prices, as of course furnaces would not sell at a loss for any length of time.

BETTER SALES ARE REPORTED

Some Lines Seem to be Gathering in Greater Volume of Business Now

TORONTO.—The price movement that seemed to be making headway last week finds little more progress this week in the machine tool market. Makers seem to be more confident that prices are not going to change. Nor are there any who claim there is a great clamor for a better figure, while on the other hand there are a few who believe that the new prices they have been able to give have helped in placing some machines.

It must not be imagined that the machine tool market in this district is at a standstill, for there are some very nice sales being made.

The automobile shops are starting to run again, and places that had contracts to make parts are getting under way. It is a rather slow process, as none of the shops feel justified in going ahead full blast until the attitude of the buyer is more marked.

Oshawa shops have taken back all their married men, and a number of single men, who were skilled in certain operations, and who had left when work fell off, are being sent for. A conservative estimate would place the operations in the shops there at 50 per cent. of normal. In Chatham and Walkerville the makers of cars and parts are also getting a start and expect to add to their number from time to time.

Inquiries are better, although it is still difficult to convert these into new business. Nearly all these inquiries are

new ones in the market, and for the most part are pretty well scattered.

Some of the sales that have been made in Ontario particularly are the result of a lot of work on the part of the salesmen. In some cases it has been possible to show firms where they could make a real saving by changing equipment, or where present equipment could be supplemented to advantage by some additions. The past few weeks has provided a good time to get this work done in order to be ready for the start which is now being made in several of the plants.

The buyers are in possession of the steel market, and they know it. Any purchaser who has a good-sized order seldom places it at once. One of the steel merchants, speaking about this a few days ago, remarked that, "Every order, especially if it is of any size, is being peddled to the limit now, and by the time the buyer has made the rounds he has a price that is pretty close to what he wants to pay."

"And are prices sagging as a result?" was asked.

"In some cases they are," was the answer. "Just now warehouses are working off as much of their stock as possible, and when they see a chance to get rid of a slice by naming a close figure they are going to do it. In fact, if it is going to bring business into the market, they have to do it as buyers are needed just now as much or more than they ever have been before."

Another merchant, who has been doing some aggressive publicity work, stated that the first of the week had seen a nice lot of business coming in, more than they had taken in for some time previously. They did not want to place the interpretation on this that business was permanently better, but for the meantime they were willing to admit that the orders were the best they had seen for some weeks past.

None of the warehouses are taking in much material. What is coming in is simply by releasing some of the orders that have been held up.

Both mills and warehouses are out looking for business just now, and prices are suffering a little as a result. Bars, for instance, have been quoted at 4.75 per pound for some time past, but better than that has been done right along, so this week we are changing the figure to 4.50, at which price the bulk of the sales are being put through.

Local steel men are watching with interest the developments at Pittsburgh, the general feeling being that the price of bars will not go much below 2 cents, as costs are still high, and a revision of wage schedules will cause more or less trouble and make buyers look for still greater reductions.

Tube business is coming in fairly well, although the orders are very scattered and smaller than usual. Sheets are quiet, the demand being limited. Plate is not selling to any extent.

MACHINE TOOL BUILDERS MEETING IN CLEVELAND TO DISCUSS PLANS

Special to Canadian Machinery.

NEW YORK, Feb. 24.—The National Machine Tool Builders' Association will meet on Thursday of this week in Cleveland to discuss the present business situation.

Among the specific subjects scheduled for the conference are "The Present Business Situation and How to Meet It," "Principles of Sound Financing for the Machine Tool Industry" and "How to Run a Machine Tool Shop in a Time of Depression." In connection with these subjects the plans of the executive committee of the association for the adoption of a uniform cost finding method will be under consideration. It is believed by many that the cut-throat competition which existed in the machine tool trade prior to the war was due largely to an imperfect knowledge of costs. The association's executive committee has employed a firm of accountants, Scovell, Wellington & Co., Boston, who have been conducting an investigation during the past few months under the guidance of E. F. Du Brol, general manager of the association. Six district meetings were held at which cost data were produced by all members of the association, and from these data average cost prices have been arrived at to be used as the basis for the cost finding system.

The machine tool trade is making rather slow progress toward an improved business condition. In fact, in some lines it is doubtful whether any progress at all is being made. Some machine tool companies which up to this time have been working at least a few days a week are now seriously considering shutting down their plants entirely, as they no longer feel justified in building machines for stock at present high costs. While buyers naturally point to the continued high prices of tools, it is not in accord with the facts to say that any considerable amount of machine tool business is being held back solely because of high prices. As long as there is so little work for machine tools to do, it follows that there cannot be much demand for tools. In other words, until there is a much better demand for the products which are made on machine tools there cannot be a much better demand for the tools themselves.

Domestic inquiry and sales are light. A little foreign business is trickling through, principally from Japan. The Japanese navy has been buying quietly in this country for a month or so. Among other export inquiries are some from India and Russia.

CANADIAN ENGINEERING SKILL TO HELP OPEN UP MORE NEW MARKETS

Canada is having a large part in development work that is taking place on the Gold Coast of Africa. H. F. Walker, of Edmonton, who passed through Toronto a few days ago, is one of the first of a field force of about 50 Canadian engineers who will share in the money to be made in the "big job"—which is to open up the rich provinces of the Gold Coast, Nigeria, Togoland and the Cameroons. The entire undertaking to which Stewart & MacDonnell are committed with the Home Government will involve expenditures through them by Great Britain of approximately $60,000,000, work on the first unit beginning April 15, to be completed within seven years, and cost in approximately close figures $7,000,000.

Canadians Direct Work

Not only will Canadian brains direct operations, but the heads of all departments will be men of Canada, a party of 50 following within 30 days. London operations will be personally directed by Hon. Angus MacDonnell. He was one of the contractors building the Cowichan Lake extension of the C. P. R. lines on Vancouver Island a short while ago. Canadian material and equipment also are to be used as extensively as possible in the Gold Coast operations, transport charges considered and later Canadian cars, steam shovels, locomotives, cement, etc., are to be sent over by shiploads, expectations being that at least $2,500,000 worth of British Columbia Douglas fir alone will be required. Mills at Chemainus are now working on the first orders and looking for bottoms to transport the initial and later cargoes.

New Markets For Canada

Hydrographic surveys, preliminary to the work, have been conducted during the past year under the direction of Rear-Admiral Sir John Parry, who, during the war, was engaged in surveys for the Admiralty on the Canadian coast. It is expected that development of these hitherto untouched domains of Africa will foster important new markets not only for Great Britain, but particularly for Canada.

New Premises.—The Diamond State Fibre Company of Canada, Limited, are moving into new premises in the Wrigley Building, Carlaw Avenue, Toronto, on or about March 1. This building is twice as large as their present premises. A private railway siding will facilitate greatly the delivery of shipments.

Price Tendencies of Iron, Steel and Copper

THE lack of enough energy to establish a new market level is probably what leaves the U.S. Steel Corporation and its Industrial Board prices as the recognized standard in the steel world.

How long that position can be sustained is a matter of pure and simple guessing, wherein one man's guess is as good as another's.

A definite move has been made by some of the independents toward a lower price—in fact the idea seems to be just now to find out where to establish a price level that will cause buyers to come out and take hold.

The Pittsburgh correspondent of Canadian Machinery says that the price of bars is now recognized at 2c pound, or $7 per ton under the Industrial Board prices. A further drop is hardly to be expected from this figure.

It is interesting to compare this with previous quotations from Pittsburgh. Below we show high and low prices from 1912 to 1919, as well as yearly averages:

Year	High	Low	Average
1912	1.40	1.10	1.25
1913	1.40	1.22	1.38
1914	1.22	1.05	1.15
1915	1.75	1.10	1.31
1916	2.93	1.87	2.48
1917	4.50	2.90	3.49
1918	2.90	2.78	2.89
1919	2.70	2.35	2.43

The ten-year average for years previous to the time covered by this table, say from 1904 to 1913, puts bars at 1.403c per pound. So it will be seen that the Industrial Board price at 2.35 is fairly well removed from that figure. The average from 1912 to the end of 1919 is 2.04c per pound, the average being shoved up by the prices of 1917, for taking that year out the average from 1912 to the end of 1919 is 1.84c per pound.

Pig Iron Prices Compared

Pig iron is having a difficult time standing up to any supposed schedule and a determined effort seems to be under way to batter it down to $25, which would be well above the average of previous normal years. Here is the showing for a ten-year period from 1910 to 1919, taking Buffalo quotations, as that is the principal point of competition Canadians have to meet:

Year	High	Low	Average
1910	17.25	14.50	15.55
1911	14.25	13.50	13.84
1912	17.61	13.62	14.89
1913	17.25	13.07	14.87
1914	13.50	12.08	12.84
1915	17.77	12.44	13.98
1916	33.56	18.00	20.63
1917	50.64	33.39	40.41
1918	35.25	33.50	33.97
1919	39.19	27.00	30.53

Worked out, it will be seen that the average for those years is $21.16 per ton. This figure has been brought up by the inclusion of high-cost war years. Take the first six years of that period, 1910 to 1915, and it is seen that Buffalo was selling pig iron at an average of $14.38 per ton.

The war years, when the effect was felt on pig, viz., 1916-17-18, shows an average at the same point of $31.67 per ton. The quotation for Buffalo at this writing is $29.25 to $31.25 per ton, or a half-way price of $30.25 per ton.

Summarized, it gives these results:

Ten year's average, 1910 to 1919	$21.16
Six year's average, 1910 to 1915	14.38
War year's average, 1916-17-18	31.67
Present average	30.25

It is not the purpose of this article to go into the matter of costs, which have increased very largely on every hand. Nor has there been any advances made in the way or method of production that would serve to cut prices, for methods used now are to all intents and purposes the same as in the pre-war, cheap-cost years.

The Case of Copper

Copper is one of the metals that has taken its "bumps." The statement is made in the trade now that copper cannot be produced at the price at which it is sold to-day, and there is no good reason to doubt the statement. As a matter of fact copper for the thirty-year period from 1890 to 1919 averaged 15.68c per pound, while the quotation at this writing is 13½c per pound.

The highest price on record for Lake copper on the New York market was in 1864 at 55c per pound and the lowest point recorded was in 1894 at 9c per pound. In the war years copper fared well, touching 36c in 1917.

Where Sheets Stand

The prices on which the following tables and quotations are based are at Pittsburgh. Sheets are usual black sheets, No. 28 gauge. One would hardly believe that at the end of 1914 and the beginning of 1915 sheets were quoted at 1.70 to 1.80c per pound. Take the ten-year performance, 1910 to the end of 1919:

Year	High	Low	Average
1910	2.40	2.15	2.29
1911	2.20	1.84	2.03
1912	2.25	1.80	2.00
1913	2.35	1.98	2.20
1914	1.98	1.80	1.89
1915	2.53	1.74	1.93
1916	4.40	2.60	3.06
1917	8.00	4.50	6.29
1918	5.00	4.82	4.98
1919	4.70	4.35	4.43

That makes the average of that period 3.11 per pound, hardly a fair comparison. Taking out the three wild years, 1917-18-19, it gives an average of 2.20 for the first seven years, 1910-16. The present price at Pittsburgh is 4.35, although there have been departures from this. Summarized, it gives:

Ten years, 1910-19, average	3.11
Seven years, 1910-16, average	2.20
Present price	4.35
Average 1917-18-19-20	5.01

These four lines, bars, copper, pig and sheets, have been taken because they are quite representative of the iron, steel and metal classes. Copper alone has done more than its share toward coming down to a working basis and it is a very safe guess that the improvement of industrial conditions, already under way, will bring copper up from its lowly position. Iron and steel have so far stood more or less aloof from the tendency of prices to skid. They have receded greatly from some of the "peaks," but these peaks cannot be accepted as market standards, most of them being brought about by the persistent desire of the consumer to secure prompt delivery regardless of price.

B. J. McCORMICK,
General Sales Manager, Canada Foundries & Forgings, Ltd., Welland.

Strategic Loss Essential to an Effective Offensive

We Are in the Midst of Reconstruction Instead of at the End of It—All Sections Must Have Their Bumps

THAT a strategic loss is essential to an effective offensive in present business conditions, is the view held by B. J. McCormick, general sales manager of Canada Foundries and Forgings, Limited. Speaking to the Ontario Retail Hardware Association in Hamilton a few days ago, Mr. McCormick reviewed many phases of the situation that have a very direct bearing on the machine tool, small tool, iron and steel markets in general.

Referring to business prospects for 1921, Mr. McCormick said that "consciously or unconsciously factory managers are answering this question by the plans which they are now laying for future operations. No one can answer correctly with assurance, but a knowledge of conditions and the economic laws that govern those conditions will aid in making the answer more authoritative. All the ablest theorists and members of the oldest and wisest schools of economics have guessed during the last three months about what was the matter with industry, and what would happen within the near future. You ask for my opinion, but all I intend to do is to discuss the matter with you.

"The year 1920 with its profits and losses, and mostly losses, has passed into history. There are several viewpoints from which to look into 1921. The productive and distributing machinery of Canada is very finely balanced and it is a well-known fact that all industry and commerce prospers and suffers together. We have experienced seven-year periods of depression or trade fluctuation. The average length of previous depressions have been about one year, some of shorter periods and some longer.

Reconstruction

"Most merchants seem to think that one big slash in prices would have the same effect as a fairy waving her wand, that all our troubles would at once vanish and be over, and that our readjustment would be completed. A good many of us thought that the year 1920 was to be the readjustment period, but we were all wrong. The year 1920 started with an unprecedented demand for every article known to commerce, and factories were so crowded with work that they had no time to readjust. In fact, labor asked for and received more concessions in 1920 than during any previous year of the war. During the month of April, 1920, we offended our customers by refusing to bid on over a million dollars' worth of inquiries because our production chart was filled for the entire year on that class of goods.

"Then came the shock, and industry mediately went into low gear about October, and here we are.

"My opinion is that this is the real period of readjustment, and our whole industrial and commercial structure is being tested by the strain, but those who have builded wisely and well have no cause for alarm.

It Rests With Steel

"My personal vision of the future is bright, pleasant and a reassuring one, but the process of reconstruction must continue until every factor contributes to the result which we attain. Wheat, cotton, tobacco, sugar, leather, rubber, lumber tea, and coffee and other raw materials, including copper and zinc, have taken a big slump in the last three months, some of them going even below pre-war prices, but I wish to call your attention to the one point which I wish to impress upon you to-day, and that is, that iron ore is the only raw material which has held firm.

"Why? Because wages have not been revised by the steel interests who perform the first seven processes of this great industry.

"Manufacturing implies buying. If nobody wants to buy what the factories make, the factories very soon have to switch off the power and put a padlock on the door. There never has been a time and there never can be a time when nobody wants to buy; but enough people can stop buying, or can curtail their buying, to make a big dent in manufacturing processes and that is just what has happened in this country at this time. There has been, and at the present time of writing there still is, a buyers' strike. It was, and is, psychological. Nobody could have done anything to prevent it. No one alone and unassisted can do very much to stop it. Buying is based on confidence—confidence that prices are fairly stable—that they will not decline recklessly over night. This is true of both individuals and of corporations. It is clear that business and industry in general must take certain broad steps before confidence is returned. It remains for the industry, whether it be manufacturer, jobber, or retailer, that has not already done so, to make the plunge; to sacrifice if sacrifices are necessary, but in any event to get back again on a workable basis of confidence. What we all want to know to-day is when will that period of relative stability likely be reached, and then and only then will the wheels of commerce speed up.

"In New York there was a meeting in January of jobbers at which they formed a policy to trade among each other, rather than purchase direct from manufacturers. Their slogan was 'Don't buy anything from the maker until he is down to pre-war prices.'

"This buyers' strike will and has slowed up production in our factories with all its disastrous effects of non-employment. Slow production begets higher costs.

Pig Iron

"This is an expression used by most hardware buyers, 'Pig iron is down $5 or $10 per ton.' This is a stock phrase and generally used as an opener with most of the hardware salesmen. Do not use this poor, old, hackneyed phrase because it shows at once that you are not familiar with the basic principles of your own business, and it makes you look like

a man coming into a ball game at the seventh inning, and asking your neighbor what is the score. It would be just as reasonable for you to ask the price of iron ore at Lake Erie ports, or even more reasonable still to ask what is the rate of pay at the mines at Oliver, Minn.

"The foundation of the whole structure known as the steel industry is what is commonly called labor. In using this word—labor—I wish to impress you with the fact that I do not use it as a hostile expression, but with thoughts most respectful and friendly. I would ask when I use the world labor that you would immediately interpret it as meaning 'Physical application of human energy, plus intelligence, knowledge and skill, applied to material things such as woods and metals.'

"Labor is the greatest contributing factor to costs in our industry to-day, and in fact, the determining one, with transportation coming next. Labor again is the chief factor in transportation charges.

U. S. Steel Method

"The United States Steel Corporation in their system of cost practice value iron ore in the ground at only 10 cents per ton because it is only just plain mud. They reason that by the application of human energy, plus intelligence and skill, and aided with modern tools and equipment and with a further application of heat, they can convert this mud into merchant bar and pass it along to the general steel working industry at a profit. I figure the steel industry on the same basis as a nine inning ball game, the seventh inning or operation is the blast furnace turning the ore into pig iron, while the eighth and ninth processes are where the metal working industries of Canada begin to function, and the greatest contributing factor which we have to reckon with is wages—because no industry with too heavy a burden in this respect can produce its wares or deliver its services at reasonable prices unless this factor of remuneration contributes.

Remuneration

"The man who first takes a rough bar of wrought iron may be a blacksmith who has only partly learned his tra and has no ambition to rise above the anvil. The best possible thing he can do with his bar of iron is to make it into horseshoes, and he congratulates himself upon his success. He reasons that the rough lump of iron is worth only three or four cents per pound and that it is not worth while to spend much time or labor upon it. However, his enormous muscle and small skill has raised the value of this lump of iron say from $1 to $10. In modern factory practice this man's remuneration would probably be based on weight, and the market price of pig iron might possibly be considered in naming a selling price.

"Along comes another artisan known as a cutler, with a little better education and a little more ambition, and looking at the blacksmith and his product says: 'Is this all you can see in that lump of iron? Give me a bar and I will show you what brain and skill plus hard work can make of it.' He has seen a little farther into the rough bar. He has studied many processes of hardening and tempering. He has acquired tools and grinding and polishing wheels and an annealing furnace. Under his hand the iron is further fused, carbonized into steel, drawn out, forged, tempered, heat soaked and quenched in liquid of some nature to improve its tempering and finally ground and polished with great care and patience. When this work is done he shows the astonished blacksmith $1,000 worth of knife blades, where the latter only saw $10 worth of crude horseshoes.

"In our present shop practice this man's remuneration would be based on count and quality.

"Along comes another artisan and looking at the product of the cutler, he says: 'Knife blades are all very well if you can make nothing better, but you haven't half brought out what is in that bar of iron.' He can see higher and better uses. The third artisan has a more delicate touch, finer perception, higher ideals, better training and superior de-

termination, which enable him to look still further into this rough bar—past the horseshoes and past the knife blades—and he turns this crude iron into the finest needles, with eyes cut with microscopic exactness. The production of the invisible points requires a more delicate process, a finer grade of skill than the cutler possessed. This feat is considered marvelous and the third artisan thinks he has exhausted all the possibilities of the iron because he has multiplied the value of the cutler's product many times.

"This man's daily remuneration would undoubtedly be based on quality only.

"Along comes still another skilled mechanic with a mind more finely organized and a still more delicate touch, more patience, more industrious and higher order of skill, together with better training, and he passes with ease by the horseshoes, the knife blades, and needles and returns the product of his bar of iron in fine hairsprings for watches. Where the others saw horseshoes, knife blades and needles only worth a few thousand dollars, his penetrating eye shows a product worth tens of thousands and following the process down still further we find the little barbed instruments used by dentists to draw out the finest branches of dental nerves being sold at a price worth hundreds of times as much per pound as gold itself.

"The remuneration of this classification of man is fixed neither on weight, count nor quality. His type is so scarce and so much in demand that he commands the maximum wage with the minimum output.

"By the application of this human energy, intelligence, skill, patience and scientific training, together with the use of modern plant equipment and machinery, our products of commerce are produced, and in some particular lines the price of pig iron per ton at the blast furnace practically has no meaning at all, because the one main thought, the one big factor that enters into the whole proposition, is the value of the human energy involved.

"These are my reasons for advising you never to use the old stereotyped phrase—that pig iron is down.

Decline Comparison

"Comparing advances of average commodities between the years 1914 and 1920 we find the following comparative views. The United States has reduced these advances 66 2-3 per cent., England 40 per cent., France 25 per cent. and Canada 30 per cent.

"Therefore, taking these other countries as a competitive basis, we must have a further average reduction of 10 per cent. to be on a par with Great Britain, or a further average reduction of 36 2-3 per cent. to be on the same footing as the United States.

Equal Contribution

"When the manufacturer and the jobber and the retail man contribute to deliver goods to the consumer and having done their bit by contributing their surplus profit, and the ultimate consumer still maintains the attitude that the price is still too high, only one factor remains, namely, wages, and if wages will not contribute, then production ceases until it does. Wages must conform to the new basis of commodity prices, not because we want it so, but from the very nature of things.

"When I use the word 'normal' I do not by any means mean to convey pre-war prices, because I feel that we could be a happier and more prosperous community if wages received their better share of reward than in the old pre-war days, and I am inclined to think that wages will.

Retailers' Attitude

"Recently the Financial Post sent out a questionnaire to the bank managers from coast to coast on which were six questions, and one of the most important questions included was: 'Is the retailer reducing prices as far as conditions warrant?' Two hundred and sixty-eight centres reported that retailers were NOT making price reductions warranted by conditions; thirty centres reported doubtful replies, and two hundred and fifteen reported Yes. The genuineness of sales being held in many places was seriously questioned by the bank managers, who pointed out that the retail trade does NOT feel disposed to take its losses.

Dull Seasons

"Dull seasons call for economies and it is always good business practice to keep your assets liquid. Cash on hand is more useful than shelves full of stagnant stock bought at prices the public will not meet. Ready money makes it possible to purchase new fresh goods at present values and puts the merchant on an up-to-date selling basis. It is sometimes better strategy in taking a loss than by sitting tight and playing a waiting game. A strategic loss nowadays seems to be essential to a most effective offensive. The manufacturers and jobbers have taken theirs—WHY NOT YOU?

"All elements in our national make-up seem to be willing to go down the bump-the-bumps but labor, and it seems to prefer to simply look on as a bystander and watch the sport.

"We are all anxious to get back to normal, but can we do so until every factor contributes, and normal wages and profits are resumed?

"Nobody knows whether prices are going down to pre-war levels or not. It does not now seem probable that they will in view of the difficulty of deflating wages; but one man's guess is as good as another, so all we can do is 'hope.' Not the hope that sits idly and waits in uncertainty, but the hope that works and makes dreams come true. Normal times will return when the minds of men become normal.

Well, Here's a Slogan

"In the meantime, let us adopt the new Canadian slogan—'Let us throw the hooks into our job instead of into each others.'"

The various processes in the production of iron from the ore, showing the relation of labor, were described as follows:

First—Steam shovel from mines and tools or burden.

Second—Railroad to upper lake port and burden ore.

Third—Dock organization—loading into boats—burden.

Fourth—Lake transportation—burden.

Fifth—Unloading at Lake Erie port—burden.

Sixth—Railway transportation to furnace—burden.

Seventh—Blasting ore into pig—burden.

Eighth—Rolling mill—pig iron into bars—burden.

Ninth—Manufacturing bars into tools, etc.

Note—It takes four tons of iron ore besides limestone and coke to make one ton of steel. Three tons ore plus all its burden are waste.

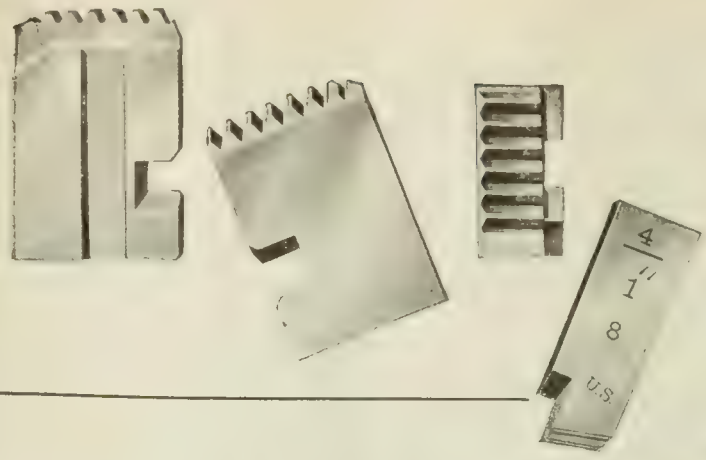
WELL, HERE'S A SLOGAN FOR 1921

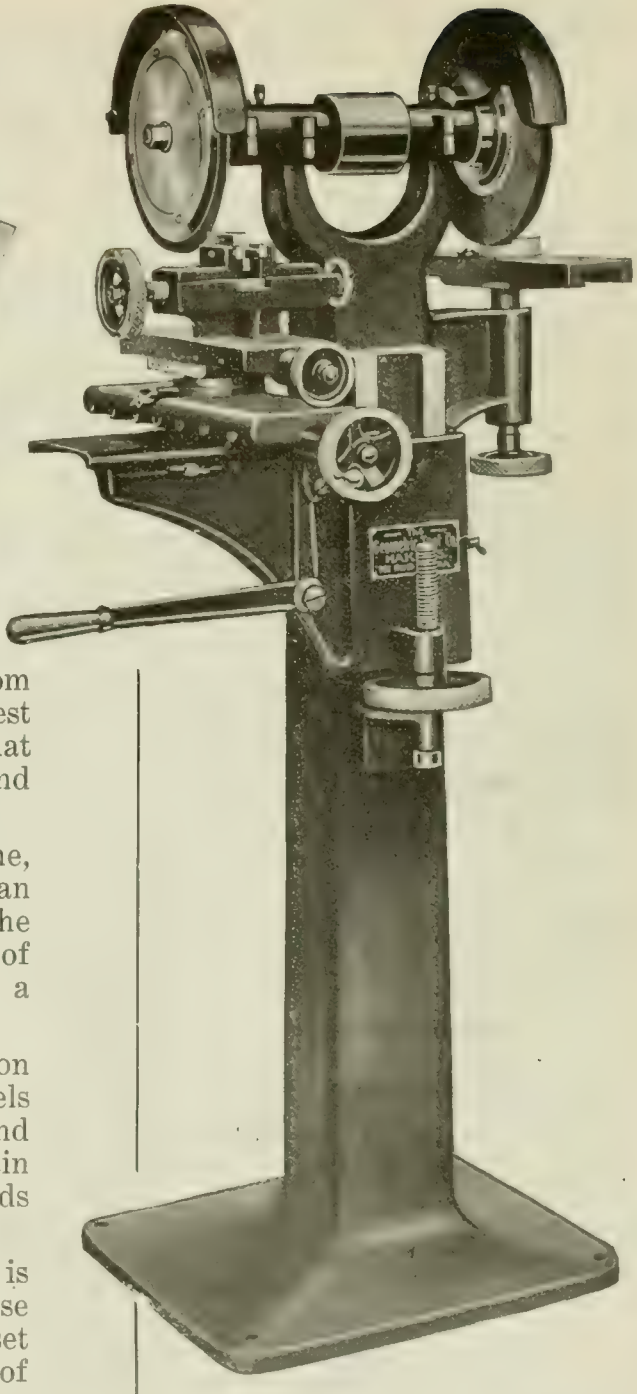
A LOT of people are spending good time right now standing around in a sort of business circle, wondering when the other chap is going to come down—wondering if some competitor is going to come along and cut the ground from under his feet—wondering if things are going to get much worse before they start to get better—wondering if they can throw the harpoon into some competitor who looks as though he were getting ready to make a start.

Well, in this address Mr. McCormick hands out a pretty good cure for this sort of business dizziness and industrial liver complaint. Short, but pithy, here it is:—

"Let us throw the hooks into our jobs instead of into each other."

Pretty fair, isn't it? We don't know whether it came out of the Welland shop, whether it has been heat-treated or quenched, but it has quite a little sermon in it just the same.





Sharp Chasers Cut Clean Threads

Accurate, uniform threads result only from chasers which are maintained in the highest state of cutting efficiency. This means that chasers must be kept sharp, and ground uniformly.

Even if just touched up from time to time, the chasers respond splendidly, with clean threads. And with this machine — the Geometric Chaser Grinder—the matter of keeping threading tools up to scratch is a comparatively simple matter.

Various makes of chasers can be ground on this adaptable machine. The two wheels permit the easy grinding of both milled and tapped chasers. In addition, the plain wheel lends itself readily to various kinds of tool grinding.

Uniform grinding of a set of chasers is purely a mechanical matter through the use of adjustments which can be accurately set to govern the grinding of an entire set of chasers.

The Catalogue describing this machine is a mine of information on chaser grinding. Write for it.

THE GEOMETRIC TOOL COMPANY

NEW HAVEN, CONNECTICUT

Canadian Agents:

Canadian Fairbanks-Morse Co., Ltd., Manitoba, Saskatchewan, Alberta

Williams & Wilson, Ltd., Montreal. The A. R. Williams Machinery Co., Toronto, Winnipeg, St. John, N.B., Halifax, N.S.

If interested tear out this page and place with letters to be answered.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products.

PIG IRON

Grey forge, Pittsburgh	$32 46
Lake Superior, charcoal, Chicago	40 50
Standard low phos., Philadelphia	33 25
Bessemer, Pittsburgh	33 96
Basic, Valley furnace	30 00
Toronto price:—	
Silicon, 2.25% to 2.75%	39 25

IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$ 4 50
Steel bars, base, Toronto	4 50
Iron bars, base, Montreal	4 25
Steel bars, base, Montreal	4 25
Reinforcing bars, base	4 50
Steel hoops	6 00
Tire steel	5 00
Spring steel	8 00
Band steel, No. 10 gauge and 3-16 in. base	5 50
Chequered floor plate 3-16 aud heavier	7 50
Bessemer rails, heavy, at mill	2 35
Steel bars, Pittsburgh	3 00-4 00
Tank plates, Pittsburgh	3 50
Structural shapes, Pittsburgh	2 45
Steel hoops, Pittsburgh	3 05
F.O.B., Toronto Warehouse	
Small shapes	5 00
F.O.B. Chicago Warehouse	
Steel bars	3 48
Structural shapes	3 58
Plates	3 78
Small shapes under 3-in.	3 48

FREIGHT RATES

Per 100 Pounds.

Pittsburgh to Following Points

	C.L.	L.C.L.
Montreal	58½	73
St. John, N.B.	84½	106½
Halifax	86	108
Toronto	38	54
Guelph	38	54
London	38	54
Windsor	35	50½

METALS

	Gross. Montreal	Toronto
Lake copper	$18 50	$17 50
Electric copper	18 00	17 50
Castings, copper	17 75	18 00
Tin	39 00	40 00
Spelter	7 75	7 50
Lead	6 75	7 50
Antimony	8 00	8 25
Aluminum	34 50	30 00

Prices per 100 lbs.

PLATES

Plates, 3-16 in.	$ 5 25	$ 5 50
Plates, ¼ up	4 75	5 50

PIPE—WROUGHT

Standard Buttweld Pipe

Per 100 Ft.

	Steel Blk.	Steel Galv.	Gen. Wrought Iron Blk.	Gen. Wrought Iron Galv.
⅛	$ 6 50	$ 8 50	$.....	$.....
¼	5 31	7 41	5 91	8 01
⅜	5 31	7 41	5 91	8 01
½	7 10	8 63	7 95	9 48
¾	8 80	10 87	9 95	12 02
1	13 01	16 07	14 71	17 77
1¼	17 60	21 74	19 90	24 04
1½	21 04	25 99	23 79	27 84
2	28 31	34 97	32 01	38 67
2½	44 75	55 28	....	....
3	58 52	72 29	....	....
3½	74 06	90 62	....	....
4	87 75	107 37	....	....

Standard Lapweld Pipe

Per 100 Ft.

	Steel Blk.	Steel Galv.	Gen. Wrought Iron Blk.	Gen. Wrought Iron Galv.
2	$32 01	$ 38 67	$35 71	$42 37
2½	48 26	58 79	54 11	64 64
3	63 11	76 88	70 76	84 53
3½	75 90	92 46	85 10	101 66
4	89 93	107 55	100 83	120 45
4½	1 05	1 29	1 30	1 54
5	1 22	1 50	1 52	1 80
6	1 58	1 95	1 97	2 33
7	2 06	2 53	2 53	3 01
8L	2 16	2 66	2 66	3 16
8	2 49	3 07	3 07	3 64
9	2 98	3 67	3 67	4 36
10L	2 77	3 41	3 41	4 05
10	3 56	4 39	4 39	5 21

Prices—Ontario, Quebec and Maritime Provinces

WROUGHT NIPPLES

4-in. and under, 50 per cent.

4½-in. and larger, 40 per cent.

4-in. and under, running thread, 20%.

Standard couplings, 4-in. and under, 20%

Dd., 4½-in. and larger, net.

OLD MATERIAL

Dealers' Average Buying Prices

Per 100 Pounds.

	Montreal	Toronto
Copper, light	$10 50	$ 9 00
Copper, crucible	13 00	11 00
Copper, heavy	12 00	11 00
Copper wire	12 00	11 00
No. 1 machine composition	13 00	9 75
New brass cuttings	7 00	8 00
Red brass turnings	8 00	8 00
Yellow brass turnings	7 00	6 00
Light brass	5 00	5 00
Medium brass	6 50	6 00
Scrap zinc	5 00	4 00
Heavy lead	4 50	4 00
Tea lead	2 50	2 00
Aluminum	15 00	10 00

	Per Ton	Gross
Boiler plate	$11 00	$12 00
Heavy melting steel	15 00	14 00
Axles (wrought iron)	25 00	20 00
Rails (scrap)	15 00	14 00
Malleable scrap	20 00	20 00
No. 1 machine cast iron	30 00	25 00
Pipe, wrought	8 50	8 00
Car wheel	30 00	25 00
Steel axles	20 00	18 00
Mach. shop turnings	8 00	6 00
Stove plate	23 00	20 00
Cast boring	8 00	7 00

BOLTS, NUTS AND SCREWS

	Per Cent.
Carriage bolts, 7-16 and up	Net list
Carriage bolts, ⅜" and less	15
Coach and lag screws	—20
Stove bolts	55
Wrought washers	—25
Elevator bolts	Net
Machine bolts, 7-16 and over	—5
Machine bolts, ⅜-in. and less	—30
Blank bolts	Net
Bolt ends	—5
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	+25
Machine screws, fl. and rd. hd., brass	Net
Machine screws, o. and fil. hd., brass	Net
Nuts, square, blank	+25 add $2 00
Nuts, square, tapped	add 2 25
Nuts, hex., blank	add 2 25
Nuts, hex., tapped	add 2 75
Copper rivets and burrs, list less	27½
Burrs only, list plus	10
Iron rivets and burrs	37½ and 5
Boiler rivets, base ¾" and larger	$8 50
Structural rivets, as above	8 40
Wood screws, O. & R., bright	67½
Wood screws, flat, bright	67½
Wood screws, flat, brass	55
Wood screws, O. & R., brass	55½
Wood screws, flat, bronze	50
Wood screws, O. & R., bronze	47½

MILLED PRODUCTS

(Prices on unbroken packages)

	Per Cent
Set screws	Less 40%
Square and hexagon head cap screws	Less 30%
Round head cap screws	Plus 10%
Fillister head cap screws	Less 10%
Flat head cap screws	Net list
Button head cap screws	Plus 10%
Studs	Less 20%
Semi-finished nuts up to and including 1-in.	Less 35%
Semi-finished nuts 1⅛ to 1½"	Less 30%
Semi-finished nuts 1⅝ to 2 in.	Net list
Coupling bolts	Plus 10%
Taper pins	Less 40%
Planer bolts without fillet	Plus 40%
Planer bolts with fillet	Pus 50%
Patch bolts	Plus 80%
Hollow set screws	Plus 20%
Thumb screws	Less 35%
Thumb nuts	Less 65%

BILLETS

F.O.B. Pittsburgh.

	Per gross ton
Bessemer billets	$43 50
Open-hearth billets	43 50
O.H. sheet bars	47 00
Forging billets	48 50
Wire rods	57 00

NAILS AND SPIKES

Wire nails, base	$5 10
Cut nails, base	5 75
Miscellaneous wire nails	50%

ROPE AND PACKING

Plumbers' oakum, per lb.	0 10¼
Packing, square braided	0 38
Packing, No. 1 Italian	0 44
Packing, No. 2 Italian	0 36
Pure Manila rope	0 26
British Manila rope	0 20
New Zealand hemp	0 20

POLISHED DRILL ROD

Discount off list, Montreal and Toronto	Net

Shorter Work Day Means *Less Production*

Results of a Practical Test With a Work Week of 48 Hours or Less—In Some Industries Automatics Determine the Rate of Production in the Factory

AN important statement has just been released by the National Industrial Conference Board, New York, regarding the effect of the shorter work-day on production. Anything given out by this organization can be accepted in a spirit of fairness by either employer or employee, as their object is at all times to have facts available for the better understanding of any situation. The report states:

An extensive investigation of practical experience of manufacturers who, since the beginning of 1919, have reduced their weekly working schedule to 48 hours or less has shown that in a great majority of cases the reduction of hours was accompanied by a decrease in weekly output per worker, according to a report issued to-day by the National Industrial Conference Board.

Took in 436 Plants

This investigation, which is of timely interest because of the importance of the hours-of-work problem arising out of present industrial conditions, covered the collective experience of 436 manufacturing establishments employing together 373,536 workers, including establishments in the cotton, wool, silk, boot and shoe, metal, and a group of miscellaneous manufacturing industries, and ranging in size from very small plants employing only a few workers to extremely large ones with many thousands of employees. Most of the plants in the textile and boot and shoe industries were located in the East, but those in the metal and miscellaneous industries represent practically all the large manufacturing centers in the country.

In 87.2 per cent. of the establishments studied a reduction to a work week of 48 hours or less was accompanied by a decrease in weekly output per worker. In 8.7 per cent. of the plants the workers were able to maintain weekly production per worker, and in a very few cases (4.1 per cent.) weekly output per worker was increased.

In somewhat more than two-fifths of the establishments which noted a falling off in weekly production, the decrease was approximately in proportion to the reduction in hours. In about one-fifth of the establishments showing reduced weekly production, the loss in weekly output was less than proportional to the reduction in hours, and in approximately a sixth of the establishments which decreased weekly production, the decrease was greater than proportional to the reduction in hours.

It was found, the report says, that the character of the work, that is, whether the process was largely handwork or machine work, for the most part determined whether or not it was possible to increase hourly output. In those industries, such as cotton manufacturing, where highly automatic machine processes predominated, the output was limited almost entirely by the speed of the machine. In those industries, however, where hand-work predominated, or where the skill and speed of the worker in handling machines were the controlling factors—such as in the boot and shoe industry, or in certain kinds of metal manufacturing—it was possible to increase the hourly output of the workers, in some cases to the extent of entirely compensating for the loss in work time and even exceeding the previous weekly production.

Other factors which were found in the investigation to largely affect production under the reduced working schedule were the general attitude and characteristics of the working force, the supply of skilled labor, regularity in attendance, changes in the personnel of the management or the introduction of improved methods of management or the installation of different or improved machines, all of which accounted in some instances for marked increases in output.

As a rule it was not found that increases in wage rates had any effect upon the efficiency of workers, but in almost every case where a change in output was noted the pieceworkers were more successful in maintaining output than were day workers, and a bonus system in some cases proved an incentive to increased production. It was not found in this investigation that the size of the establishment in itself had any apparent relation to the ability of a plant to maintain output.

With regard to experience in various industries it was found that in cotton manufacturing all the establishments investigated experienced a decrease in weekly output under the reduced hours. In wool manufacturing only one establishment out of 60 was able to maintain weekly output, and in silk manufacturing only one out of the 23 plants studied. In boot and shoe manufacturing, out of the 88 plants covered, it was found that three were able to increase weekly output and 13 to maintain it, while in the metal manufacturing industries, out of 117 plants investigated, nine reported that their weekly output had been increased and 16 that they had been able to maintain weekly production.

FIRMS WANT TO SELL OUR GOODS

Two Glasgow Houses Are Interested in Handling Canadian Lines

Information regarding the following lines can be obtained by communicating with this paper and mentioning key numbers:

2730. **Concrete machinery.** — Glasgow firm asks to be placed in touch with manufacturers of concrete machinery, including block-making bricks and slabs, and concrete mixers. Cement equal to British standard requirements.

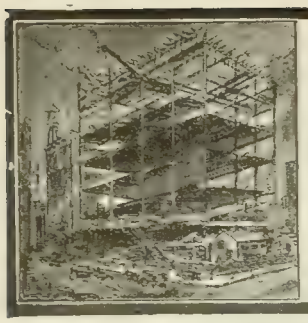
2731. **Iron and steel products** and engineering specialties.—A Glasgow firm wishes to hear from Canadian manufacturers of iron and steel products and engineering specialties.

SEMI-AUTOMATIC TAPPING MACHINE

A semi-automatic multiple-spindle tapping machine has been developed by the Langelier Manufacturing Company, of Arlington, R.I., which is quite similar to designs previously brought out by this firm. The main spindle is driven by means of a motor located beneath the machine, and by means of belting and gears. The spindles in the multiple head are crank driven and are secured with fixed centres in bronze bearings. The tapping heads are made interchangeable so that different layouts may be obtained. A feature of the machine is the arrangement of the spindle so that taps of different pitch may be used on the different spindles, each tap following its own lead. The work is carried on a table that is raised automatically at the same speed as that of the tap entering the work. The machine is stopped automatically when the tap has entered the desired distance.

The coal mining industry promises to become the most important enterprise of the island of Formosa. Production has risen from less than 350,000 tons in 1914 to over 1,000,000 tons in 1919, and it is estimated that by next year the mines will be close to a 2,000,000-ton basis. In 1919, exports, principally to Hong Kong, Philippine Islands, Shanghai, and Singapore, accounted for approximately 480,000 tons; bunker sales were 100,000 tons; while Formosan consumption was estimated at 570,000 tons. The total coal deposits of Formosa are variously estimated at figures between 691,840,000 tons and 850,000,000 tons. Production could be greatly increased, and an output of as much as 5,000,000 tons per annum is easy of attainment, were it not for defective harbor and transport facilities.

If interested tear out this page and place with letters to be answered.



INDUSTRIAL NEWS

NEW SHOPS, TENDERS AND CONTRACTS
PERSONAL AND TRADE NOTES

BALDWINS INTEND TO MAKE THEIR OWN STEEL BARS AT TORONTO PLANT

LONDON, England.—The ever-growthe meetings of the boards of the manufacturing corporations in the industrial development of Canada is again demonstrated in a recent statement made by Sir John Roper Wright, Bart., chairman of Baldwins, Limited, the big English firm of engineers.

Addressing the shareholders at Birmingham Sir John said that he was pleased to be able to say that Baldwins' enterprise in Canada was proceeding satisfactorily, and had now reached the manufacturing stage. They had held, as was well known, a very valuable and long-established connection in Canada for their various products, and in order to retain that they found it necessary, owing to the ever-increasing American competition in that market, to consider means of combating it. Therefore, when it was brought to their notice by their agents in Canada that the site and plant of the British Forgings, Limited, at Ashbridge's Bay, Toronto, was for disposal they decided after careful consideration and investigation to enter into negotiation for the purchase, which was completed at the end of May, 1919.

The works as then existed comprised, in addition, to machine and pattern shops, etc., a most modern and well-equipped foundry which proved of great assistance to them in the manufacture of various castings required during construction of the rolling mills. They have also a battery of ten electric furnaces, some of which are being utilized for the manufacture of steel castings.

Will Have Sixteen Mills

"Four out of the eight mills we have put down are engaged in the manufacture of black and tin plates and galvanized sheets," Sir John Roper Wright said, "the other four are now ready. We have the foundations laid for another eight mills, and the finishing departments are already fully equipped to deal with the output of sixteen mills. We are not yet producing our own steel bars, but it is our intention to do so eventually. We have made a very promising start, and can now confidently look forward to not only retaining, but considerably expanding our trading operations in Canada."

The establishment in the Dominion of Baldwins, with a working capital of £8,000,000 sterling, and a world-known name, is fraught with gratifying possibilities for the expansion of Canadian trade. Other British concerns of outstanding importance are watching with interest the progress of the British firms who have acquired interests in Canadian industry with a view to following their example, and undoubtedly the placing of British capital in existing Canadian manufacturing plants or the actual establishment of branch factories will become in the near future a prominent factor in the industrial expansion of the Dominion.

ON LONG TRIP FOR HIS COMPANY

T. A. Ross, of Armstrong-Whitworth, Has Been Spending Few Weeks in Canada

T. A. Ross, of Armstrong-Whitworth Co., Elswick, Eng., has been in Eastern Canada for several weeks, leaving a day or so ago for Vancouver, on the way to New Zealand. His firm is interested in large installations there, and also in Australia, and Mr. Ross expects to spend some time there before leaving for other points. He will call at various points in New Guinea, China, India, Malta and other places before returning to the old country, expecting in all to be away for at least two years and to cover 20,000 miles yet before reaching home.

Speaking to a representative of Canadian Machinery Mr. Ross stated that industrial conditions in England were still in the process of changing from war conditions to peace, and that it might take a little time yet for labor to become accustomed to the new rates it would be possible to pay under the changed conditions. He was quite certain, though, that under all the trouble that appeared on the surface, conditions were solid and good and would work out all right.

A special train was run to Sault Ste. Marie on February 21, taking expert medical aid to Charles E. Duncan, superintendent of the Algoma Steel Corporation. Mr. Duncan is suffering from an attack of acute appendicitis.

MERGER THROUGH IN SMALLER SHAPE

British Empire Steel Corporation Takes on Form in New Arrangement

MONTREAL.—At the conclusion of ing participation of leading British Dominion Steel Corporation and the Nova Scotia Steel & Coal Companies, it was officially announced that directors of these companies had arrived at an agreement for the consolidation of the Dominion Steel Corporation, Ltd., the Nova Scotia Steel & Coal Co. and the Halifax Shipyards, Ltd., under the name of the British Empire Steel Corporation, Ltd.

The agreements are subject to the underwriting of certain securities, upon the completion of which the boards of the companies will again meet for the purpose of approving the underwriting and fixing the date when the agreements will be laid before the shareholders of the interested companies for their approval.

No indication of what the amount to be underwritten will be is given, or in what form it will be, so that the next meeting of the directors for its approval is a matter of conjecture.

The amalgamation of the Dominion Steel Corporation and the Nova Scotia Steel & Coal Company has been considered by some a logical proposition, owing to the situations and workings of the two industries. The inclusion of the Halifax Shipyards will come as a surprise to some, but not to others. The Canada Steamship Lines have not been mentioned, although a cable from London states that in an interview with Col. Grant Morden the latter says the steamship company will closely co-operate.

Any appendage to the amalgamation of the two big steel concerns will be a source of disappointment to many in the street here, who had hoped that the two enterprises would work alone, their merging having been advocated for years.

Possibly the greatest feat in the history of the telephone took place a few days ago when a man in Ottawa called up a friend in Vancouver. The call was routed via Montreal, New York, Chicago, San Francisco and Vancouver, which is a distance of about 4,500 miles. This has been made possible as the result of the scientific research of the past quarter century.

INTERESTING CATALOGUE

The Mason Regulator and Engineering Co., Ltd., Montreal, P.Q., have issued a new catalogue of their products. Every means of condensing the information has been adopted and the data have been made short and concise as possible. In other words it is a condensed catalogue. Should a reader of the book desire further information he is told how to secure it from the larger specialized catalogues published by this firm.

Engineering

Tenders will be opened on March 1 for the erection of the proposed new palatial hotel at Windsor, Ont., for the Border Cities Hotel Company.

W. Davidson & Co., 188 Duke Street, Toronto, have received the general contract for repairs to factory for Burgess Mfg. Co., 35 Brant Street, Toronto.

A factory will be erected at Welland, Ont., by the British-American Drug Co., Ltd., which recently incorporated under a provincial charter with a capital of $300,000.

Tenders will be called in March for the erection of factory, estimated to cost $25,000, for British Columbia Impermeaite Co., Ltd., Seventh Avenue West, Vancouver.

The Baltimore Drydocks & Shipbuilding Co., Baltimore, on February 17 cut the wages of 3,000 of their 4,000 employees. The cut amounted to approximately 10 per cent.

The F. R. Dingwall Co., Winnipeg, Man., are erecting a warehouse on Albert Street. Carter-Halls-Aldinger Co., Ltd., Union Bank Bldg., have secured the general contract.

Tenders are expected to be called shortly for the erection of hotel, theatre and stores, estimated to cost $125,000, for the Peninsula Hotel and Amusement Co., Ltd., St. Catharines, Ont.

John Hayman & Sons, 432 Wellington Street, London, Ont., have received the general contract for erecting an addition to factory costing $35,000 for E. Leonard & Sons, York Street.

Plans have been prepared by F. S. Mallory, architect, 164 Bay Street, Toronto, for warehouse to cost $14,000 and addition to garage, $3,000, for Lake Simcoe Ice Co., corner Jarvis and King Streets.

Incorporations

Graveline and Kennedy, Ltd., has been incorporated with capital stock of $150,000 with head office at Quebec City, to carry on the business of wholesale and retail importers and exporters of sporting goods generally—bicycles, motorcycles, automobiles, etc.

Brydges Limited, with capital stock of $100,000, head office at Montreal, has been granted incorporation to carry on business of iron masters and of manufacturers and rollers of steels and iron, into any and all forms.

Sumbling Machinery Co., Ltd., with capital stock of $1,000,000, has been incorporated with head office at Toronto, to carry on the business of manufacturing, buying, selling, repairing, etc., of washing machines, ironers, and all kinds of laundry and other machinery.

Trade Gossip

Big Season's Work.—It was announced on February 19, by Mayor Church, after a conference with Finance Commissioner Ross and Chief Engineer Cousins of the Harbor Commission, that they hoped to do between two and three million dollars worth of work on the Toronto Harbor during the coming season.

Change in Business.—Announcement is made to the effect that the Cincinnati Milling Machine Company has become financially interested in the Cincinnati Grinder Company. It is purposed to manufacture the latter company's line of universal and plain cylindrical grinding machines and internal grinding machines in the plant of the Cincinnati Milling Machine Company. The latter company has recently made extensive plant additions.

Gravity Carrier Company.—At a meeting of the shareholders of the Matthews Gravity Carrier Company at Port Hope, it was shown that the past year had been a satisfactory one, and that prospects for the future were good. Mr. F. P. Moore, of Ellwood City, Pa., occupied the chair. The following officers were elected: President, F. B. Moore; vice-president, O. C. Sylvester; treasurer and managing director, L. O. Sylvester; secretary, A. Richly.

A New Section.—A new section of the Montreal branch of the Canadian Manufacturers' Association to be known as the "Steel and Iron" section has been organized. It is stated that there were over 150 firms in Montreal engaged in the manufacture of iron, steel or machinery and other metallic goods, and it is expected that this branch will eventually become one of the most important in the local organization. Steps are also being taken to organize other sections, including the dry goods, electrical apparatus, leather goods and foodstuffs trades.

Run Open Shop.—The Robert Mitchell Co., Ltd., 64 Belair St., Montreal, who have been making heavy castings in their foundry for the last five years, have made some new installations in their plant during the last year and are now operating on a new basis and specializing in a jobbing shop business in high-grade, light, soft iron castings. Amongst the improvements in their plant is the installation of seven Arcade air squeezers and an overhead trolley. A notable change in policy of this company towards their employees is the announcement that since the foundrymen's strike of May 1st last they have been operating on an open shop basis, replacing their former policy of the closed shop, which had always been in force in this plant.

27 NEW FIRMS IN HAMILTON IN 1920

Report of Industrial Commissioner Shows That Progress Has Been Quite Marked

Industrial Commissioner Kirkpatrick has presented his annual report to Hamilton Board of Control. New industries with capital of $7,440,000 were located during the year. The following is the list:—

Canadian Libbey-Owens Sheet Glass Co., sheet glass.
Electric Material & Products Co., electric lamps.
Peterson Core Oil Co., oils and chemicals.
Canadian Nathan Co., brass goods.
Maple Leaf Milling Co., flour and feed.
W. D. Shambrook & Co., aluminum ware
Tresidder Bros., Ltd., paper boxes.
Canadian Sidecar Co., sidecars.
Sapon Soap Co., Ltd., soaps.
Mortimer & Richmond, soaps.
Malone & Morley, ice cream cones.
Canada Color Type Co., embossed enamelware.
Don-O-Lac Co. of Canada, shellacs.
Canadian Metlskin Co., boiler room supplies.
Hamilton Soap Co., soaps.
Candy Specialties, Ltd., candies.
Hamilton Pleating Co., pleated goods.
Motor-Meter Co., motometers.
Never Fail Products, sheet metal products.
Orange Crush Rolling Co., soft drinks.
Hamilton Aluminum Co., aluminum.
Spinning Mill for Canada Cottons, Ltd.
Wire Products Mill for Steel Co. of Canada.
Pocock Manufacturing Co., flat rods.
Taylor Brasco Co., Ltd., store fronts.
Imperial Oil Co., divisional headquarters
Canadian Line Material Co.

SCRAP MARKET STILL VERY QUIET

Dealers Claim They Can't Afford To Either Go In To Buy or Sell

The scrap metal market remains where it has been for some weeks, in the dumps. The market for yellows appears to be very narrow. Estimates have it that there are 400,000,000 pounds of copper in the United States market just now, and this cannot possibly be marketed for a good many months to come.

Dealers are in the peculiar position of not being able to either buy or sell, claiming they can't afford it either way. The stock they are holding was, for the most part, taken in at a much higher price than could be secured for it today, hence they feel they cannot afford to sell. On the other hand, they are afraid of prices, although they are low, and for that reason claim they cannot afford to buy. So there the matter stands.

Many of the yards are not making expenses, in fact some of them are taking losses every day they are in business at the present.

CANNOT CANCEL THE ORDER HERE

Cutler-Hammer Mfg. Co., Announce a Reduction and State Their Policy

Cutler-Hammer Mfg. Co., of Milwaukee, have sent out the following notice:—

"Please be advised that an approximate 10 per cent. reduction of all controller prices has been effected as of February 14th by a change in discounts.

"All orders received bearing date after February 14th will be shipped at the reduced price. All orders now in the house will be shipped at price in effect at time of receipt and will not be subject to cancellation."

The briquette plant at Bienfait, Sask., which is subsidized by the Manitoba, Saskatchewan and Federal Governments, will begin manufacturing briquettes early in May, it was announced. The buildings are completed and only a little additional machinery remains to be installed. Several tests will be made before the briquettes are placed on the market. The plant was built at a cost of $500,000.

Classified Opportunities

MACHINE WORK WANTED

MACHINE WORK WANTED FOR LATHES, shapers, milling machine and planer, etc. Hourly or contract basis. Prompt delivery. W. H. Sumbling Machinery Co., Toronto. (ctfm)

AGENCIES WANTED

SOLE AGENCIES WANTED BY WELL-known, reputable and established English engineering firm, represented all over the world, for Contractors' or Municipalities' small Engineering equipment, which must be first-class, competitive in price, and in constant large demand. British made and patented preferred; if Colonial or Foreign privilege of manufacturing in England required. Big sales assured for the right Equipment. Write giving details to "Engineering," P.O. Box 1934, Montreal. (c8m)

HELP WANTED

WANTED AS ASSISTANT EDITOR. ON group of technical papers, live-wire mechanical engineer. Qualifications required are: Age, under 45; good education; certain amount of practical experience; ability to express ideas on paper; good mixer and aggressive worker. Splendid opportunity for the right man. State full particulars in first letter, mentioning present salary. Box 152, Canadian Machinery.

POSITIONS WANTED

YOUNG MAN, MARRIED, 35 YEARS, AMERI-can, technical and metallurgical training, tool room foreman, superintendent or manager. Position where opportunity assured. Combined shop and office experience. Box 55, Canadian Machinery, 128 Bleury St., Montreal. (c9m)

I WILL BE IN A POSITION WITHIN TWO weeks to accept charge of a drop forge, or machinery blacksmithing plant. Can design all types of bending and forming dies, and have had 30 years' experience in this class of work. Box 753, Canadian Machinery.

MECHANICAL ENGINEER WITH 16 YEARS' experience in mechanical shops and drawing offices, executive for the last 7 years, and 2 years' selling experience, is looking for responsible position with good manufacturing concern. Familiar with building construction, plant maintenance, fire protection, and efficiency principles. Age 35. Box 754, Canadian Machinery. (c9m)

PARTIAL LIST

Machine Shop Equipment

At Extremely Low Prices

LATHES—All sizes and lengths of bed. Special price quoted on rebuilt 20 in. x 8 ft. C.M.C.

AIR COMPRESSOR—8 in. x 8 in. Chicago Pneumatic.

TANKS—10 Tanks 10 ft. 6 in. diam. x 29 ft. 6 in. long. 19,000 gals.
3 Tanks, 10 ft. 0 in. diam. x 39 ft. 0 in. long, ⅜ in. Heads. 22,893 gals.
Full line of other Steel Storage Tanks, open and closed, all sizes.

PUMPS—1 Triplex Power Pump, 1½ in. x 6 in. Hydraulic Machy. Co. Also 1 in. x 5 in. West Tire Setter.
1—Centrifugal Pump, 2½ in. x 1½ in. Gould.
1—Gould Triplex Power Pump, 2 in. x 3 in.

Milling Cutters and Reamers, full assortment, all sizes and shapes, at less than half price. Send us your enquiries.

Standard Equipment & Tool Works

Dept. K. 307 St. James St.
Main 2286 MONTREAL
(20)

PATTERNS

TORONTO PATTERN WORKS, 65 JARVIS Street, Toronto. Patterns in wood and metal for all kinds of machinery. (ctfm)

BRANTFORD PATTERN WORKS ARE PREpared to make up patterns of any kind—including marine works—to sketches, blue prints or sample castings. Prompt, efficient service. Bell 'Phone 631; Machine 'Phone 733. Brantford Pattern Works, 49 George St., Brantford, Ont. (ctfm)

PATTERNS

Wragge's Pattern Works, 10 George St. South, Galt, Ont., Phone 1105 W. Equipped for best service in wood or metal patterns to any specification. Most reasonable prices. Expert workmanship. "Nothing ragged but the name." (cxxvi3m)

Modern Marine Machinery

Automatic Steam Towing Machines, Ship Windlasses, Cargo and Deck Winches, Steam Capstans, Dock Gypsies, Steering Engines, Hydraulic Freight Hoists, etc. Grey Iron and Brass Castings. Special machinery built to order. The Corbet Foundry & Machine Co., Limited, Owen Sound, Ont. (52)

MACHINE WORK WANTED

We are equipped to handle all kinds of general or special machine work. All operations in our plant are done under the most careful supervision and we can satisfy you as to price. Always available for consultation.

PERFECT MACHINE COMPANY, GALT
Builders of Reliable Machinery.

Grey Iron Castings

Light and Medium-Bench and Floor Repetition Castings; Capacity 15 tons per day.
Expert Metal and Wood Pattern Work. Our advice and estimates will save you money.
Semi-finishing operations on Lathe or Grill on Castings supplied if required.
ASK US.
THE KATIE FOUNDRY, GALT, ONT.

REGO
WELDING
and
CUTTING
APPARATUS

Oxygen, Acetylene, and a complete line of Welding and Cutting Supplies.

Carter Welding Co.
of Toronto, Limited
7-11 Sheppard St., Toronto, Ont.
Phones: Adelaide 2841 and 1524
(TF)

MACHINERY WANTED

WANTED—NEW AND RE-MANUFACTURED gas and gasoline engines, boilers, saw-mill machinery, planing mill and sash and door factory machinery. New and manufactured iron and wood-working machinery. Electric motors, dynamos, direct connected steam operated generators, portable electric tools. Builders' hoists, elevators. Box 739F, Canadian Machinery.

IF YOU HAVE IRON-WORKING OR WOOD-working machines for sale, or idle machine shop equipment, call or write Canada's largest dealers in new and used machinery. H. W. Petrie Limited, Toronto, Ont. (cfm)

WANTED — WOODWORKING MACHINERY and mining machinery, machine tools, boilers and steam pumps, alternating or direct current motors. Contractors' equipment. Apply Box 737F, Canadian Machinery.

ONE SINGLE STAND 9 x 18 ROLL IN GOOD condition; one receiving separator, capacity about 1,000 bushels per hour. Crane Bros., 817 Ferry St., Niagara Falls, Ont.

WANTED—WOODWORKING MACHINERY OR woodworking plant. State particulars and price. Address Buyer, 249 Talbot St., St. Thomas, Ont.

FOR SALE

2—ROTARY STEAM DRIERS 6' DIAM. x 25' long; complete.
2—ENDLESS DOUBLE LEATHER BELTS, 13" x 50' total length each.
1—8" x 12" DOUBLE DRUM BEATTY HOIST and boiler.
1—6" x 12" DOUBLE DRUM BEATTY HOIST and boiler.
2—AIR COMPRESSORS, 800 FT. CAPACITY; belted.
Box 752F, Canadian Machinery.

IN WRITING ADVERTISERS, PLEASE MENTION THIS PAPER.

CANADIAN MACHINE SHOP

Will handle medium Specialty Line — Manufacturing and Selling

Apply Quickly
Box No. 715F
CANADIAN MACHINERY

Classified Opportunities

If interested tear out this page and place with letters to be answered.

HINTS TO BUYERS

Canadian Machinery BUYERS DIRECTORY

If what you want is not here, write us, and we will tell you where to get it. Let us suggest that you consult also the advertisers' index—last page of book, after having secured advertisers' names from this directory. The information you desire may be found in the advertising pages. This department is maintained for the benefit and convenience of our readers. The insertion of our advertisers' names under proper headings is gladly undertaken, but does not become part of an advertising contract.

Abrasive Discs
Norton Co. of Can., Ltd., Hamilton, Ont.
Oakey & Sons, Ltd., John London S.E., Eng.
Ritchey Supply Co., Toronto, Ont.
Wausau Abrasives Co., Chicago, Ill.

Abrasive Materials
Dom Abrasive Wheel Co., Ltd., Milnice, Ont.
Norton Co. of Can., Ltd., Hamilton, Ont.
Oakey & Sons, Ltd., John, London, S.E., Eng.
Waltham Grinding Wheel Co. of Canada, Ltd Brantford, Ont
Ritchey Supply Co., Toronto, Ont.
Wausau Abrasives Co., Chicago, Ill.

Acetylene, Dissolved
L'Air Liquide Society, Toronto, Ont.

Accumulators, Hydraulic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Stewart & Co., Duncan, Glasgow, Scot

Air Lifts
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.

Air Purifiers and Coolers
Sturtevant Co., B. F., Boston, Mass.

Analyses, Chemical
Toronto Testing Laboratory, Toronto, Ont.

Angle Bars
Steel Co. of Canada, Ltd., Hamilton, Ont.

Anvils
Aikenhead Hardware Ltd., Toronto, Ont.
Atkins & Co., Inc., E. C., Indianapolis, I.
Columbia Hdwe. Division, Cleveland, O.
Petrie, Ltd., H. W., Toronto, Ont.

Arbors
Atkins & Co., Inc., E. C., Indianapolis, I.
Brown & Sharpe Mfg. Co., Providence, R.I.
Cleveland Twist Drill Co., Cleveland, O.
Ford-Smith Machine Co., Hamilton, Ont
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Jacobs Mfg. Co., Hartford, Conn.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Skinner Chuck Co., New Britain, Conn.

Axles, Car
Dom. Foundries & Steel, Hamilton, Ont.

Babbitt Metal
Atkins & Co., Inc., E. C., Indianapolis, I.
British Smelting & Refining Co., Ltd., Montreal, Que.
Canada Metal Co., Ltd., Toronto, Ont.
Fisher Motor Co., Ltd., Orillia, Ont.
Hoyt Metal Co., Toronto, Ont.
Magnolia Metal Co., Montreal, Que.
Tallman Brass & Metal Co., Hamilton, Ont.

Balls, Brass, Bronze and Steel
Canada Foundries & Forgings Co., Welland, Ont.
Canadian SKF Co., Toronto, Ont.
Dominion Foundries & Steel, Ltd., Hamilton, Ont.
Pilot Steel & Tool Co., Montreal, Que.
Railway Roller Bearing Co., Syracuse, N.Y.

Barrels, Tumbling
Baird Machine Co., Bridgeport, Conn.
McDougall Co., Ltd., R., Galt, Ont.

Bars, Boring
Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Gisholt Machine Co., Madison, Wis.
Madison Mfg. Co., Muskegon, Mich.

Bars, Boring, Portable
Underwood Corp., H. B., Philadelphia, Pa

Bars, Bronze Cored
Moore & Son, Thos., Montreal, Que
Tallman Brass & Metal Co., Hamilton, Ont.

Bars, Iron
Steel Co. of Canada, Ltd., Hamilton, Ont.

Bars, Steel
Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont.
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Canada Foundries & Forgings Co., Welland, Ont.
Can. Steel Foundries, Montreal, Que.
Dom. Foundries & Steel, Hamilton, Ont.
N. S. Steel Co., Ltd., New Glasgow, N.S.
Pilot Steel & Tool Co., Montreal, Que.
Steel Co. of Canada, Ltd., Hamilton, Ont.
United Alloy Steel Corp., Canton, Ohio.
Vanadium Alloys Steel, Latrobe, Pa.

Bearings, Ball
Canadian SKF Co., Toronto, Ont.
Chapman Double Ball Bearing Co., Toronto, Ont.
Lang Mfg. Co., Guelph, Ont.
Lyman Tube & Supply Co., Montreal, Que.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Railway Roller Bearing Co., Syracuse, N.Y.

Bearings, Bronze
Tallman Brass & Metal Co., Hamilton, Ont.
Railway Roller Bearing Co., Syracuse, N.Y.

Bearings, Die-Cast
Fisher Motor Co., Ltd., Orillia, Ont.
Franklin Die-Casting Corp., Syracuse, N.Y.
Tallman Brass & Metal Co., Hamilton, Ont.

Bearings, Journal
Fisher Motor Co., Ltd., Orillia, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Bearings, Roller
Lang Mfg. Co., Guelph, Ont.
Lyman Tube & Supply Co., Montreal, Que.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Pilot Steel & Tool Co., Montreal, Que.
Railway Roller Bearing Co., Syracuse, N.Y.

Belt Cement
Graton & Knight Mfg. Co., Worcester, Mass.
McLaren Belting Co., J. C., Montreal, Que.

Belt Clamps
Graton & Knight Mfg. Co., Worcester, Mass.

Belt Dressings and Fillers
Aikenhead Hardware Ltd., Toronto, Ont.
Dom. Belting Co., Ltd., Hamilton, Ont.
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Graton & Knight Mfg. Co., Worcester, Mass.

Belt Fasteners
Can. Consolidated Rubber Co., Ltd., Montreal, Que.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Graton & Knight Mfg. Co., Worcester, Mass.
McLaren Belting Co., J. C., Montreal, Que.
Rice Lewis & Son, Ltd., Toronto, Ont.

Belt Lacing
Clipper Belt Lacer Co., Grand Rapids, Mich.
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Graton & Knight Mfg. Co., Worcester, Mass.
McLaren Belting Co., J. C., Montreal, Que.

Belt Lacing Machines
Clipper Belt Lacer Co., Grand Rapids, Mich.
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
McLaren Belting Co., J. C., Montreal, Que.
Petrie, Ltd., H. W., Toronto, Ont.

Belt Tools
Graton & Knight Mfg. Co., Worcester, Mass.

Belting, Chain
Can. Link-Belt Co., Toronto, Ont.
Jones & Glassco, Montreal, Que.
Lyman Tube & Supply Co., Montreal, Que.
Morse Chain Co., Ithaca, N.Y.
Renold (Hans) of Canada, Ltd., Montreal, Que.

Belting, Fabric
Atkins & Co., Inc., E. C., Indianapolis, I.
Can. Consolidated Rubber Co., Ltd., Montreal, Que.
Goodyear Tire & Rubber Co. of Can., Ltd., Toronto, Ont.
Dom. Belting Co., Ltd., Hamilton, Ont.
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Foss Machinery & Supply Co., Geo. F., Montreal Que.
McLaren Belting Co., J. C., Montreal Que.
Sumner & Co., New York City.

Belting, Leather
Atkins & Co., Inc., E. C., Indianapolis, I.
Can. Fairbanks-Morse Ltd., Montreal, Q.
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Graton & Knight Mfg. Co., Worcester, Mass.
McLaren Belting Co., J. C., Montreal, Que.
Smith Belting Co., Toronto, Ont.
Sumner & Co., New York City.
Tullis & Son, Ltd., John, Glasgow, Scot.

Belting, Rubber
Can. Consolidated Rubber Co., Ltd., Montreal, Que.
Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont.
Gutta Percha & Rubber, Toronto, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

Belts, Abrasive
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Oakey & Sons, Ltd., John, London, S.E., Eng.

Bench Countershaft Standards
Ford-Smith Machine Co., Hamilton, Ont

Benches, Work
Aikenhead Hardware Ltd., Toronto, Ont.

Bending Machines, Power
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Bertrams Ltd., Edinburgh, Scotland.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Williams Machinery Co., A. R., Toronto, Ont.

Bins, Ore
MacKinnon Steel Co., Sherbrooke, Que.

Blocks
Ford Chain Block Co., Philadelphia, Pa.
Wright Mfg. Co., Lisbon, Ohio.

Blocks, Chain (See Hoists, Hand)
Aikenhead Hardware Ltd., Toronto, Ont.
Ford Chain Block Co., Philadelphia, Pa.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Wright Mfg. Co., Lisbon, Ohio.

Blocks, Die
Canada Foundries & Forgings Co., Welland, Ont.
Canadian Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Dom. Foundries & Steel, Hamilton, Ont.
Fisher Motor Co., Ltd., Orillia, Ont.
Swedish Crucible Steel Co. of Canada, Ltd., Windsor, Ont.

Blocks, Pillow
Can. Link-Belt Co., Toronto, Ont.

Blowers
Can. Blower & Forge Co., Ltd., Kitchener.
General Combustion Co. of Can., Ltd., Montreal, Que.
Petrie, Ltd., H. W., Toronto, Ont.
Sheffield Engineering Supplies, Ltd., Montreal, Que.
Skinner Bros. Mfg. Co., Inc., St. Louis, Mo
Sturtevant Co., B. F., Boston, Mass.

Bolt and Nut Machinery
Acme Machinery Co., Cleveland, Ohio.
Bertram & Son Co., Ltd., The John, Dundas, Ont
Garlock-Walker Mchy. Co., Toronto, Ont.
Greenfield Tap & Die Corp., Galt, Ont.
Landis Machine Co., Inc., Waynesboro, Pa
National Machinery Co., Tiffin, Ohio.
Victor Tool Co., Waynesboro, Pa.

Bolt and Nut Machinery, Automatic
National Acme Co., Cleveland, Ohio.

Bolts and Nuts
London Bolt & Hinge Works, London, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
National Acme Co., Cleveland, Ohio.
N. S. Steel Co., Ltd., New Glasgow, N.S.
Petrie, Ltd., H. W., Toronto, Ont.
Steel Co. of Canada, Ltd., Hamilton, Ont

Bolt Threading Die Heads
Jones & Lamson Machine Co., Springfield, Vermont.
Landis Machine Co., Inc., Waynesboro, Pa.

Boosters
Sturtevant Co., B. F., Boston, Mass.

Boring and Turning Mills, Vertical
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Gisholt Machine Co., Madison, Wis.
Herbert Ltd., Alfred, Toronto, Ont.

Boring, Drilling and Milling Machines, Horizontal
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Gisholt Machine Co., Madison, Wis
Herbert Ltd., Alfred, Toronto, Ont.
Landis Tool Co., Waynesboro, Pa.

Boring, Drilling and Milling Mach., Vertical
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
McDougall Co., Ltd., R., Galt, Ont.
Oliver Machinery Co., Grand Rapids, Mich.
Petrie, Ltd., H. W., Toronto, Ont.

Boring Heads
Aikenhead Hardware Ltd., Toronto, Ont.

Boring Tools
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Armstrong Bros. Tool Co., Chicago, Ill.
Gisholt Machine Co., Madison, Wis.

Brakes, Magnetic (for electric furnaces)
Volta Mfg. Co., Welland, Ont.

Brass
Brown's Copper & Brass Rolling Mills, Ltd., Toronto, Ont.

Bricks, Fire
Elk Firebrick Co. of Can., Ltd., Hamilton, Ont.

Bridges
Hamilton Bridge Works Co., Ltd., Hamilton, Ont.
MacKinnon Steel Co., Sherbrooke, Que.

Broaching Machines
Bilton Machine Co., Bridgeport, Conn.
Garlock-Walker Mchy. Co., Toronto, Ont.

Bronze
Brown's Copper & Brass Rolling Mills, Ltd., Toronto, Ont.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Bronze, Phosphor
British Smelting & Refining Co., Ltd., Montreal, Que
Canada Metal Co., Ltd., Toronto, Ont.

Bucket Carriers, Pivoted
Can. Link-Belt Co., Toronto, Ont

Buffing or Polishing Machines (See Polishing and Buffing Machines)
Can. Hanson & Van Winkle Co., Ltd., Toronto, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
U.S. Electrical Tool Co., Cincinnati, O.

Bulldozers
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.

Burners, Oil and Gas
General Combustion Co. of Can., Ltd., Montreal, Que.
Rockwell Co., W. S., New York City.

Bushings
Fisher Motor Co., Ltd., Orillia, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.

Cabinets, Oil
S. F. Bowser & Co., Ltd., Toronto, Ont.

Calipers
Brown & Sharpe Mfg. Co., Providence, R.I.
Starrett Co., L. S., Athol, Mass.

Cams
Canada Foundries & Forgings Co., Welland, Ont

Can-Making Machinery (See Sheet Metal Working Machinery
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
MacKinnon Steel Co., Sherbrooke, Que.

Cars, Ore
MacKinnon Steel Co., Sherbrooke, Que.

Castings, Aluminum
Canada Electric Castings Co., Ltd., Orillia.
Can. Hanson & Van Winkle Co., Toronto, Ont.
Canada Metal Co., Ltd., Toronto, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

BUYERS' DIRECTORY

Castings, Brass and Bronze
Algoma Steel Corp., Ltd., Sault Ste Marie, Ont.
Canada Electric Castings Co., Ltd., Orillia.
Can Hanson & Van Winkle Co., Toronto, Ont.
Canada Metal Co., Ltd., Toronto, Ont.
Can. Driver-Harris Co., Walkerville, Ont.
Electric Steel & Engineering Co., Welland, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Castings, Copper
Can Hanson & Van Winkle Co., Toronto, Ont
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Castings, Marine
Can. Steel Foundries, Montreal, Que
Dominion Foundries & Steel, Ltd., Hamilton, Ont.

Castings, Die Molded
Fisher Motor Co., Ltd., Orillia, Ont.
Franklin Die-Casting Corp., Syracuse, N.Y.
Katie Foundry Co., Galt, Ont.
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Castings, Ferro-Alloy
Can. Steel Foundries, Montreal, Que.

Castings, Iron
Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont.
Bernard Industrial Co., A., Fortierville, Que.
Bilton Machine Co., Bridgeport, Conn.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Can. Hanson & Van Winkle Co., Toronto, Ont.
Canada Electric Castings Co., Ltd., Orillia
Hanna & Co., M. A., Cleveland, Ohio.
Hepburn Ltd., John T., Toronto, Ont.
Katie Foundry Co., Galt, Ont.
Kennedy & Sons, Wm., Owen Sound, Ont.
McDougall Co., Ltd., R., Galt, Ont.
Victoria Foundry Co., Ltd., Ottawa, Ont.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Castings, Hyd. Press
Can. Steel Foundries, Montreal, Que.

Castings, Monel Metal
Can. Driver-Harris Co., Ltd., Walkerville, Ont.

Castings, Naval Bronze
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Castings, Nichrome
Can. Driver-Harris Co., Walkerville, Ont.
Electric Steel & Engineering Co., Welland, Ont.
Hull Iron & Steel Foundries, Hull, Que
Katie Foundry Co., Galt, Ont.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Castings, Nickel
Can. Hanson & Van Winkle Co., Toronto, Ont.

Castings, Semi-Steel
Davidson Mfg. Co., Thos., Montreal, Que.
Hull Iron & Steel Foundries, Hull, Que.
Katie Foundry Co., Galt, Ont.
Manitoba Steel Foundries, Ltd., Winnipeg, Man.

Castings, Steel
Dominion Foundries & Steel, Ltd., Hamilton, Ont.
Can. Steel Foundries, Montreal, Que.
Kennedy & Sons, Wm., Owen Sound, Ont.
Swedish Crucible Steel Co. of Can., Ltd., Windsor, Ont.

Cements, Iron
Smooth Mfg. Co., Jersey City, N.J.

Centering Machines
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont

Chains (See Sprockets and Chains)
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Morse Chain Co., Ithaca, N.Y.
Philadelphia Gear Works, Philadelphia, Pa.
Renold (Hans) of Canada, Ltd., Montreal, Que.
Wright Mfg. Co., Lisbon, Ohio.

Chains, Driving
Can. Link-Belt Co., Toronto, Ont.
Greenfield Tap & Die Corp., Galt, Ont.
Jones & Glassco, Montreal, Que.
Morse Chain Co., Ithaca, N.Y.
Renold (Hans) of Canada, Ltd., Montreal, Que.
Wright Mfg. Co., Lisbon, Ohio

Chasers
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Jones & Lamson Machine Co., Springfield, Vt
Landis Machine Co., Inc., Waynesboro, Pa.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Chemists
Toronto Testing Laboratory, Toronto, Ont.

Chucking Machines
Cleveland Tool Co., Cincinnati, Ohio
Brown & Sharpe Mfg. Co., Providence, R.I.
Gisholt Machine Co., Madison, Wis

Jones & Lamson Machine Co., Springfield, Vermont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

Chucks, Drill
Jacobs Mfg. Co., Hartford, Conn.

Chucks, Drill and Tap
Aikenhead Hardware Ltd., Toronto, Ont.
Canadian SKF Co., Toronto, Ont.
Cushman Chuck Co., Hartford, Conn.
Dom. Steel Products Co., Brantford, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Williams & Wilson, Ltd., Montreal, Que.

Chucks, Lathe
Aikenhead Hardware Ltd., Toronto, Ont.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Cushman Chuck Co., Hartford, Conn.
Dom. Steel Products Co., Brantford, Ont.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Geometric Tool Co., New Haven, Conn.
Gisholt Machine Co., Madison, Wis.
Ker & Goodwin Machine Co., Brantford, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Williams & Wilson, Ltd., Montreal, Que

Chucks, Magnetic
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Chucks, Planer
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Cushman Chuck Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.

Chucks, Vertical Boring Mill
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Gisholt Machine Co., Madison, Wis.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.

Clamps, Machinists'
Columbia Hdwe. Division, Cleveland, O.
Dickow, Fred C., Chicago, Ill.
Starrett Co., L. S., Athol, Mass

Cleaners, Metal, Waste, General
Oakley Chemical Co., New York, N.Y.

Clocks, Time
Gisholt Machine Co., Madison, Wis.
International Business Machines Co., Toronto, Ont.

Clutches, Friction
Bernard Industrial Co., A., Fortierville, Que.
Can. Link-Belt Co., Toronto, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Johnson Machine Co., Carlyle, Manchester, Conn.
Positive Clutch & Pulley Works, Toronto, Ont.

Coal and Ash Handling Machinery
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Can. Link-Belt Co., Toronto, Ont.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.

Coal-Storage Systems
Can. Link-Belt Co., Toronto, Ont.

Collars, Shaft or Set
Canada Foundries & Forgings Co., Welland, Ont.
Can. Link-Belt Co., Toronto, Ont.

Collets
Ackworthie, Ltd., John, Birmingham, Eng
Butterfield & Co., Inc., Rock Island, Que
Canada Machinery Corp., Galt, Ont.
Hendey Machine Co., Torrington, Conn.
Kearney & Trecker Co., Milwaukee, Wis.
Petrie, Ltd., H. W., Toronto, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Compounds, Carburizing, Case Hardening and Tempering
Cataract Refining Co., Toronto, Ont.

Compounds, Cleaning
Can Hanson & Van Winkle Co., Ltd., Toronto, Ont
Oakley Chemical Co., New York, N.Y.

Compounds, Cutting, Drilling, Grinding, Screw Cutting
Atkins & Co., Inc., E. C., Indianapolis, I.
Cataract Refining Co., Toronto, Ont.
Oakley Chemical Co., New York, N.Y.

Compressors, Air
Curtis Pneumatic Machinery Co., St. Louis, Mo.

Compressors, Air and Gas
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Petrie, Ltd., H. W., Toronto, Ont.

Cones, Friction
Norton Co. of Can., Ltd., Hamilton, Ont.

Connecting Rods and Straps
Canada Foundries & Forgings Co., Welland, Ont.

Contract Work
Ford-Smith Machine Co., Hamilton, Ont.
Skinner Bros Mfg Co., Inc., St. Louis Mo
Victoria Foundry Co., Ltd., Ottawa, Ont.

Conveyors and Elevators (See Elevators)
Jones & Glassco, Montreal, Que.
Main Belting Co. of Can., Montreal, Que.
Mathews Gravity Carrier Co., Port Hope, Ont.

Copper
Brown's Copper & Brass Rolling Mills, Ltd., Toronto, Ont.

Cored Bronze Bars
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Cotter Pins
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.

Counterbores
Cleveland Twist Drill Co., Cleveland, O
Eclipse Counterbore Co., Ltd., Walkerville, Ont.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Counters, Revolution
Aikenhead Hardware Ltd., Toronto, Ont.
Starrett Co., L. S., Athol, Mass.

Countershafts
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Foundries & Forgings Co., Welland, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Johnson Machine Co., Carlyle, Manchester, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
McDougall Co., Ltd., R., Galt, Ont.

Countersinks
Butterfield & Co., Inc., Rock Island, Que.
Eclipse Counterbore Co., Ltd., Walkerville, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Couplers, Car and Locomotive
Can. Steel Foundries, Montreal, Que.

Couplings, Flexible
Hobbs Co., Ltd., Montreal, Que

Couplings, Rigid
Bernard Industrial Co., A., Fortierville, Que.

Couplings, Shaft
Bilton Machine Co., Bridgeport, Conn.
Can. Link-Belt Co., Toronto, Ont.

Cranes, Electric
Bertram & Son Co., Ltd., The John Dundas Ont
Can. Link-Belt Co., Toronto, Ont.
Dominion Bridge Co., Ltd., Lachine, Que
Hepburn Ltd., John T., Toronto, Ont
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont

Cranes, Hand (See Hoists, Hand)
Dominion Bridge Co., Ltd., Lachine, Que
Hepburn Ltd., John T., Toronto, Ont
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont
Sheffield Engineering Supplies, Ltd., Montreal, Que.

Cranes, Locomotive
Can. Link-Belt Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.

Cranes, Traveling
Bertram & Son Co., Ltd., The John Dundas, Ont.
Can. Link-Belt Co., Toronto, Ont.
Dominion Bridge Co., Ltd., Lachine, Que
Hepburn Ltd., John T., Toronto, Ont.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.

Crank Pin Turning Machines
Garlock-Walker Mchy. Co., Toronto, Ont
Herbert Ltd., Alfred, Toronto, Ont.
Underwood Corp., H. B., Philadelphia, Pa.

Cutters, Flue
Holden Co., Ltd., Montreal, Que.

Cutters, Gear
Armstrong Whitworth Co. of Can., Ltd., Montreal, Que.
Brown & Sharpe Mfg. Co., Providence, R.I.
Butterfield & Co., Inc., Rock Island, Que.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Cutters, High Speed
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Atkins & Co., Inc., E. C., Indianapolis, I.
Bilton Machine Co., Bridgeport, Conn.
Butterfield & Co., Inc., Rock Island, Que.
Eclipse Counterbore Co., Ltd., Walkerville, Ont.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Kearney & Trecker Co., Milwaukee, Wis.
Madison Mfg. Co., Muskegon, Mich.
Pilot Steel & Tool Co., Montreal, Que.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Cutters, Milling
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Bilton Machine Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R.I.
Butterfield & Co., Inc., Rock Island, Que.
Cleveland Milling Machine Co., Cleveland.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Kearney & Trecker Co., Milwaukee, Wis.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pilot Steel & Tool Co., Montreal, Que.

Cutters, Stay Bolt
Acme Machinery Co., Cleveland, Ohio.
Landis Machine Co., Inc., Waynesboro, Pa.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Cutters, Thread
Butterfield & Co., Inc., Rock Island, Que.
Greenfield Tap & Die Corp., Galt, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesboro, Pa.

Cutting-Off Machines
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Brown & Sharpe Mfg. Co., Providence, R.I.
Garlock-Walker Mchy. Co., Toronto, Ont.
Greenfield Tap & Die Corp., Galt, Ont.
Petrie, Ltd., H. W., Toronto, Ont
Starrett Co., L. S., Athol, Mass

Cutting-Off Machines, Pipe (See Pipe Cutting and Threading Machines)
Landis Machine Co., Inc., Waynesboro, Pa.
McDougall Co., Ltd., R., Galt, Ont.
Williams Tool Corp. of Can., Ltd., Brantford, Ont.

Cutting-Off Tools
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Armstrong Bros Tool Co., Chicago, Ill.
Pilot Steel & Tool Co., Montreal, Que.

Cutting Oil Filters (See Oil Filtering Systems)
Bowser, S. F., & Co., Ltd., Toronto, Can.
Cataract Refining Co., Toronto, Ont.

Cutting, Oxy-Acetylene
Carter Welding Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Can., Toronto, Ont.
Turner Brass Works, Sycamore, Ill.
Union Carbide Co. of Can., Welland, Ont.

Cutting, Oxy-Hydrogen
National Lead Products Ltd., Toronto, Ont

Dealers, Machinery (See Searchlight Section)
Ford-Smith Machine Co., Hamilton, Ont.
Petrie, Ltd., H. W., Toronto, Ont.

Deckle Straps
Can. Consolidated Rubber Co., Ltd., Montreal, Que.

Diamonds, Black and Rough
Joyce-Koebel Co., Inc., New York, N.Y.

Diamond, Carbon and Bortz
Joyce-Koebel Co., Inc., New York, N.Y.

Diamond Tools
Aikenhead Hardware Ltd., Toronto, Ont.
Can. Desmond-Stephan Co., Hamilton, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Wheel Trueing Tool Co., Detroit, Mich.

Diamond Crossings
Can. Steel Foundries, Montreal, Que

Die-Castings
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Dies, Pipe-Threading
Jones & Lamson Machine Co., Springfield, Vt.

Die Sinking Machines, Automatic
Jones & Lamson Machine Co., Springfield, Vt.
Walcott Lathe Co., Jackson, Mich

Die Sinkers
Kimber & Hillier, St. Catharines, Ont.

Dies, Screw and Thread Cutting
Ackworthie, Ltd., John, Birmingham, Eng.
Butterfield & Co., Inc., Rock Island, Que.
Greenfield Tap & Die Corp., Galt, Ont.
Jardine & Co., A. B., Hespeler, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.
National Acme Co., Cleveland, Ohio

Dies, Sheet-Metal and Sub-Press (See Tool Work)
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Fisher Motor Co., Ltd., Orillia, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Toledo Machine & Tool Co., Toledo, Ohio.

Dies, Forging
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Canada Foundries & Forgings Co., Welland, Ont.
Canadian Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Kimber & Hillier Mfg. Co., St Catharines, Ont

BUYERS' DIRECTORY

Dies, Hammer
Kimber & Hillier, St. Catharines, Ont.

Dies, Self-Opening, Adjustable
Geometric Tool Co., New Haven, Conn.
Herbert Ltd., Alfred, Toronto, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesboro, Pa
Murchey Machine & Tool Co., Detroit, Mich.
National Acme Co., Cleveland, Ohio.
Prest-O-Lite Co. of Can., Toronto, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Victor Tool Co., Waynesboro, Pa.

Dies, Threading-Opening
Jardine & Co., A. B., Hespeler, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Murchey Machine & Tool Co., Detroit, Mich
National Acme Co., Cleveland, Ohio
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Rapid Tool & Machine Co., Lachine, Que.

Disc Cement
Ritchey Supply Co., Toronto, Ont
Wausau Abrasives Co., Chicago, Ill

Dividing Heads
Ackworthie, Ltd., John, Birmingham, Eng
Dickow, Fred. C., Machinery Co., Chicago, Ill.
Ford-Smith Machine Co., Hamilton, Ont
Hendey Machine Co., Torrington, Conn
Kearney & Trecker Co., Milwaukee, Wis
Petrie, Ltd., H. W., Toronto, Ont.

Dogs, Lathe and Milling Machine
Armstrong Bros. Tool Co., Chicago, Ill.

Drafting Boards and Tables
Darling Bros., Ltd., Montreal, Que
Economy Drawing Table & Mfg Co., Adrian, Mich.
Hughes Owens Co., Ltd., Montreal, Que.

Drafting Materials
American Lead Pencil Co., New York City, N.Y.
Darling Bros., Ltd., Montreal, Que.
Economy Drawing Table & Mfg. Co., Adrian, Mich.
Hughes Owens Co., Ltd., Montreal, Que.

Dressers, Grinding Wheel
Dom. Abrasive Wheel Co., Ltd., Mimico, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Joyce-Koebel Co., Inc., New York, N.Y.
Norton Co. of Can., Ltd., Hamilton, Ont.
Oliver Machy Co., Grand Rapids, Mich

Drill Holders
Armstrong Bros Tool Co., Chicago, Ill

Drill Rods
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Aikenhead Hardware Ltd., Toronto, Ont
Canadian Atlas Crucible Steel Co., Ltd., Toronto, Ont.

Drill Speeders
Canada Machinery Corp., Galt, Ont.

Drilling Machine Heads
Henry & Wright Mfg. Co., Hartford, Conn.
Hoefer Mfg. Co., Freeport, Ill.
United States Machine Tool Co., Cincinnati, Ohio.

Drilling Machines, Automatic
Hoosier Drilling Mach. Co., Goshen, Ind
National Automatic Tool Co., Richmond, Ind.

Drilling Machines, Bench
Beacon Engineering Co., Tipton, England
Can. Blower & Forge Co., Ltd. Kitchener
Henry & Wright Mfg Co., Hartford Conn
Petrie, Ltd., H. W., Toronto, Ont
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Terry & Co., John C., Birmingham, Eng
U.S. Electrical Tool Co., Cincinnati, O
Wisconsin Electric Co., Racine, Wis.

Drilling Machines, Electric and Hand
Aikenhead Hardware Ltd., Toronto, Ont.
Cincinnati Electrical Tool Co., Cincinnati, Ohio.
Foss Machinery & Supply Co., Geo F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill
Jardine & Co., A. B., Hespeler, Ont.
Wisconsin Electric Co., Racine, Wis.

Drilling Machines, Gang
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Bilton Machine Co., Bridgeport, Conn.
Garlock-Walker Mchy. Co., Toronto, Ont.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., of Canada Ltd Dundas, Ont.

Drilling Machines, Heavy Duty
Armstrong Whitworth of Canada, Ltd., Montreal, Canada
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Hoosier Drilling Mach. Co., Goshen, Ind.
Rockford Lathe & Drill Co., Rockford, Ill.

Drilling Machines, Horizontal (See Boring, Drilling and Milling Machines, Horizontal)
Canada Machinery Corp., Galt, Ont
Gisholt Machine Co., Madison, Wis
Holly, R. S., Toronto, Ont
Rockford Drilling Machine Co., Rockford, Ill
Rockford Lathe & Drill Co., Rockford Ill

Drilling Machines, Multiple Spindle
Beacon Engineering Co., Tipton, England
Bertram & Son Co., Ltd., The John Dundas, Ont.
Bilton Machine Co., Bridgeport, Conn
Henry & Wright Mfg. Co., Hartford, Conn
Hoefer Mfg Co., Freeport, Ill
National Acme Co., Cleveland, Ohio
National Automatic Tool Co., Richmond, Ind
Terry & Co., John C., Birmingham, Eng.

Drilling Machines, Pneumatic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.

Drilling Machines, Portable
Holden Co., Ltd., Montreal, Que
Independent Pneumatic Tool, Chicago, Ill
Jardine & Co., A. B., Hespeler, Ont
Wisconsin Electric Co., Racine, Wis

Drilling Machines, Radial
Bertram & Son Co., Ltd., The John Dundas, Ont
Canada Machinery Corp., Galt, Ont
Foss Machinery & Supply Co., Geo F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont
Henry & Wright Mfg. Co., Hartford, Conn
Herbert Ltd., Alfred, Toronto, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Williams Machinery Co., A. R., Toronto, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Drilling Machines, Sensitive
Beacon Engineering Co., Tipton, England
Bilton Machine Co., Bridgeport, Conn.
Henry & Wright Mfg. Co., Hartford, Conn.
Herbert Ltd., Alfred, Toronto, Ont
Hoosier Drilling Mach. Co., Goshen, Ind
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Rockford Drilling Machine Co., Rockford, Ill.
Terry & Co., John C., Birmingham, Eng
United States Machine Tool Co., Cincinnati, Ohio.
Williams Machinery Co., A. R., Toronto, Ont.
Wisconsin Electric Co., Racine, Wis.

Drilling Machines, Turret
Gisholt Machine Co., Madison, Wis.
Steinle Turret Machine Co., Madison, Wis
Williams Machinery Co., A. R., Toronto Ont.

Drilling Machines, Vertical
Aurora Tool Works, Aurora, Ind
Bertram & Son Co., Ltd., The John Dundas, Ont.
Canada Machinery Corp., Galt, Ont
Can. Blower & Forge Co., Ltd., Kitchener
Garlock-Walker Mchy. Co., Toronto, Ont
Herbert Ltd., Alfred, Toronto, Ont.
Hoefer Mfg. Co., Freeport, Ill.
Hoosier Drilling Mach. Co., Goshen, Ind
McDougall Co., Ltd., R., Galt, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Rockford Drilling Machine Co., Rockford, Ill.
Rockford Lathe & Drill Co., Rockford Ill.
Perfect Machine Co., Ltd., Galt, Ont.
Terry & Co., John C., Birmingham, Eng.
Streitinger Co. of Can., Ltd., Chas. A., Windsor, Ont.

Drills, Center
Butterfield & Co., Inc., Rock Island, Que
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Drills, High Speed Twist
Armstrong Whitworth Co. of Can., Ltd., Montreal, Que.
Butterfield & Co., Inc., Rock Island, Que
Cleveland Twist Drill Co., Cleveland, O
Can. Detroit Twist Drill Co., Walkerville, Ont.
Foss Machinery & Supply Co., Geo F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Jardine & Co., A. B., Hespeler, Ont
Morse Twist Drill & Machine Co., New Bedford, Mass
Pilot Steel & Tool Co., Montreal, Que
Pratt & Whitney Co., of Canada, Ltd Dundas, Ont
Sheffield Engineering Supplies, Ltd., Montreal, Que
Sheffield Twist Drill & Steel Co., Sheffield, Eng

Drills, Ratchet
Armstrong Bros Tool Co., Chicago, Ill
Butterfield & Co., Inc., Rock Island, Que
Cleveland Twist Drill Co., Cleveland, O
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont
Morse Twist Drill & Machine Co., New Bedford, Mass

Drills, Twist and Flat
Butterfield & Co., Inc., Rock Island, Que
Cleveland Twist Drill Co., Cleveland, O
Can Detroit Twist Drill Co., Walkerville, Ont
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Pilot Steel & Tool Co., Montreal, Que

Dust Handling Equipment
Can Blower & Forge Co., Ltd Kitchener
Skinner Bros. Mfg. Co., Inc., St. Louis Mo
Sturtevant Co., B. F., Boston, Mass

Electrical Instruments
Bristol Co., Waterbury, Conn.
Northern Electric Co., Montreal, Que

Electrical Supplies
Atkins & Co., Inc., E. C., Indianapolis, I
Diamond State Fibre Co., Toronto, Ont
Northern Electric Co., Montreal, Que.
U.S. Electrical Tool Co., Cincinnati, O

Elevating Trucks (See Trucks)
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.

Elevators and Conveyors
Can. Link-Belt Co., Toronto, Ont
Jones & Glassco, Montreal, Que
Lyman Tube & Supply Co., Montreal, Que
Main Belting Co. of Can., Montreal, Que
Mathews Gravity Carrier Co., Port Hope, Ont.

Emery Wheels (See Grinding Wheels)
Aikenhead Hardware Ltd., Toronto, Ont
Atkins & Co., Inc., E. C., Indianapolis, I
Dom. Abrasive Wheel Co., Ltd., Mimico, Ont
Ford-Smith Machine Co., Hamilton, Ont
Norton Co. of Can., Ltd., Hamilton, Ont
Waltham Grinding Wheel Co. of Canada Ltd., Brantford, Ont

Engines, Capstan
Kennedy & Sons, Wm., Owen Sound, Ont.

Engineers, Mechanical
Ford Smith Machine Co., Hamilton, Ont
Gisholt Machine Co., Madison, Wis
Hamilton Gear & Machine Co., Toronto, Ont
Perdue, W. B., San Francisco, Calif

Expanders, Tube
Garlock-Walker Mchy. Co., Toronto, Ont
Holden Co., Ltd., Montreal, Que.
Jardine & Co., A. B., Hespeler, Ont
Petrie, Ltd., H. W., Toronto, Ont.

Eyeglasses, Safety (See Goggles, Safety)
Prest-O-Lite Co. of Can., Toronto, Ont
Willson Goggles, Inc., Reading, Pa.

Fans, Electric
Can. Blower & Forge Co., Ltd., Kitchener
Northern Electric Co., Montreal, Que
Skinner Bros. Mfg. Co., Inc., St. Louis Mo
Sturtevant Co., B. F., Boston, Mass.

Fans, Exhaust
Can. Blower & Forge Co., Ltd., Kitchener
Petrie, Ltd., H. W., Toronto, Ont.
Skinner Bros. Mfg. Co., Inc., St. Louis Mo
Sturtevant Co., B. F., Boston, Mass.

Fans, Ventilating
Can. Blower & Forge Co., Ltd., Kitchener
Can. Ingersoll-Rand Co., Ltd., Sherbrooke Que.
Petrie, Ltd., H. W., Toronto, Ont.
Skinner Bros. Mfg. Co., Inc., St. Louis Mo
Sturtevant Co., B. F., Boston, Mass.

Fibre
Diamond State Fibre Co., Toronto, Ont
Northern Electric Co., Montreal, Que

File Handles
Ingersoll File Co., Ltd., Ingersoll, Ont

Files and Rasps
Atkins & Co., Inc., E. C., Indianapolis, I.
Foss Machinery & Supply Co., Geo F., Montreal, Que.
Ingersoll File Co., Ltd., Ingersoll, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Nicholson File Co., Port Hope, Ont.
Simonds Canada Saw Co., Montreal, Que.

Filing Machines
Garlock-Walker Mchy. Co., Toronto, Ont.
Oliver Machinery Co., Grand Rapids, Mich
Williams Machinery & Supply Co., A. R., Montreal, Que.

Filler, Iron (See Cements Iron)
Smooth Mfg Co., Jersey City, N.J.

Fire Extinguishers
Can. Consolidated Rubber Co., Ltd., Montreal Que

Fittings, Pipe
International Malleable Iron Co., Guelph, Ont

Flexible Shafts
Aikenhead Hardware Ltd., Toronto, Ont.

Flux, Galvanizing
British Smelting & Refining Co., Ltd., Montreal, Que

Fluxes, Welding
L'Air Liquide Society, Toronto, Ont

Forging Machinery
Acme Machinery Co., Cleveland, Ohio
Bertram & Son Co., Ltd., The John Dundas, Ont.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Canada Machinery Corp., Galt, Ont
Garlock-Walker Mchy. Co., Toronto, Ont
National Machinery Co., Tiffin, Ohio
Stewart & Co., Duncan, Glasgow, Scot.

Forgings, Drop
Canada Foundries & Forgings Co., Walkerland, Ont.
Dominion Forge & Stamping Co., Ltd., Toronto, Ont.

Forgings, Hammer
Armstrong Whitworth Co. of Can., Ltd., Montreal, Canada
Canada Foundries & Forgings Co., Walkerland, Ont.
Can. Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Dominion Bridge Co., Ltd., Lachine, Que.
Dom. Foundries & Steel, Hamilton, Ont.
Hepburn Ltd., John T., Toronto, Ont.
N. S. Steel Co., Ltd., New Glasgow, N.S.
Steel Co. of Canada, Ltd., Hamilton, Ont.

Foundry Equipment
Can. Ingersoll-Rand Co., Ltd Sherbrooke, Que.
Can Ingersoll Rand Co., Ltd., Sherbrooke, Que.
Ford-Smith Machine Co., Hamilton, Ont.
Holden Co., Ltd., Montreal, Que
McDougall Co., Ltd., R., Galt, Ont.
Petrie, Ltd., H. W., Toronto, Ont
Rice Lewis & Son, Ltd., Toronto, Ont.

Foundry Supplies
Atkins & Co., Inc., E. C., Indianapolis, I.
Rice Lewis & Son, Ltd., Toronto, Ont.
Sturtevant Co., B. F., Boston, Mass.

Frogs, Spring or Rigid
Can. Steel Foundries, Montreal, Que

Fuel Oil Burning System
General Combustion Co. of Can., Ltd., Montreal, Que.

Furnaces, Electric
Electric Furnace Construction Co., Philadelphia, Pa
General Combustion Co. of Can., Ltd., Montreal, Que.

Furnaces, Heat Treating Coal
General Combustion Co. of Can., Ltd., Montreal, Que.
Mechanical Engineering Co., Three Rivers, Que.
Rockwell Co., W. S., New York City

Furnaces, Heat Treating Oil and Gas
Armstrong Whitworth of Can., Ltd., Montreal, Canada
Bellevue Industrial Furnace Co., Detroit.
Can. Ingersoll Rand Co., Ltd., Sherbrooke, Que.
General Combustion Co. of Can., Ltd., Montreal, Que.
Mechanical Engineering Co., Three Rivers, Que
Rockwell Co., W. S., New York City
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Furnaces and Ovens, Electric
Electric Furnace Construction Co., Philadelphia, Pa
Petrie, Ltd., H. W., Toronto, Ont
Volta Mfg Co., Welland, Ont
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Furnaces, Tempering and Annealing
Brown & Sharpe Mfg. Co., Providence, R.I.
Electric Furnace Construction Co., Philadelphia, Pa.
Mechanical Engineering Co., Three Rivers, Que.
Rockwell Co., W. S., New York City
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Furniture, Machine Shop
Garlock-Walker Mchy. Co., Toronto, Ont

Gages, Comparator
Jones & Lamson Machine Co., Springfield, Vt.
Herbert Ltd., Alfred, Toronto, Ont.
Johansson Inc., C. E., Windsor, Ont
Perdue, W. B., San Francisco, Calif.
Starrett Co., L. S., Athol, Mass

Gages, Measuring (See Tool Work)
Chesterman & Co., Ltd., J., Sheffield, Eng.
Crescent Machine Co., Ltd., Montreal, Q.
Greenfield Tap & Die Corp., Galt, Ont.
Johansson Inc., C. E., Windsor, Ont
Starrett Co., L. S., Athol, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.
Johansson Inc., C. E., Windsor, Ont.

BUYERS' DIRECTORY

Gages, Snap, Thread and Cylindrical
Ackworthie, Ltd., John, Birmingham, Eng
Brown & Sharpe Mfg Co., Providence, R.I.
Greenfield Tap & Die Corp., Galt, Ont.
Johansson Inc., C. E., Windsor, Ont.
Pratt & Whitney Co. of Canada, Ltd., Dundas, Ont.

Gages, Special Measuring (See Tool Work)
Greenfield Tap & Die Corp., Galt, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Gages, Standard
Armstrong Whitworth Co of Can., Lt Montreal, Que.
Atkins & Co., Inc., E. C., Indianapolis, Johansson Inc., C. E., Windsor, Ont.

Gages, Thread
Ackworthie, Ltd., John, Birmingham, Eng.
Greenfield Tap & Die Corp., Galt, Ont.
Johansson Inc., C. E., Windsor, Ont.
Starrett Co., L S., Athol, Mass.

Garnet, Emery and Flint Paper and Cloth
Ritchey Supply Co., Toronto, Ont.

Gas, Coal Compressed
L'Air Liquide Society, Toronto, Ont.

Gas, Compressed
Prest-O-Lite Co. of Can., Toronto, Ont

Gaskets
Diamond State Fibre Co of Can., Ltd., Toronto, Ont.
Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont.
Goodyear Tire & Rubber Co of Can., Ltd., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Smooth Mfg Co., Jersey City, N.J

Gear Blanks
Canada Foundries & Forgings Co., Welland, Ont.
Can. Steel Foundries, Montreal, Que
Diamond State Fibre Co. of Can., Ltd., Toronto, Ont.
Dom. Foundries & Steel, Hamilton, Ont.
Hamilton Gear & Machine Co., Toronto Ontario
Philadelphia Gear Works, Philadelphia, Pa.

Gear-Cutting Machines
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Bilton Machine Co., Bridgeport, Conn
Brown & Sharpe Mfg. Co., Providence, R.I.
Fellows Gear Shaper Co., Springfield, Vt.
Petrie, Ltd., H. W., Toronto, Ont.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machines
Brown & Sharpe Mfg. Co., Providence, R.I.

Gears, Cast
Can. Link-Belt Co., Toronto, Ont.
Can. Steel Foundries, Montreal, Que.
Dom. Foundries & Steel, Hamilton, Ont.
Fisher Motor Co., Ltd., Orillia, Ont.
Hull Iron & Steel Foundries, Hull, Que

Gears, Cut
Brown & Sharpe Mfg. Co., Providence, R.I.
Canadian SKF Co., Toronto, Ont.
Crescent Machine Co., Ltd., Montreal, Q.
Diamond State Fibre Co., Toronto, Ont.
Dominion Bridge Co., Ltd., Lachine, Que.
Dom. Steel Products Co., Brantford, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Gardner & Son, Robt., Montreal, Que.
Hamilton Gear & Machine Co., Toronto Ontario
Hepburn Ltd., John T., Toronto, Ont.
Jardine & Co., A. B., Hespeler, Ont.
Jones & Glassco, Montreal, Que.
Lyman Tube & Supply Co., Montreal, Que
McDougall Co., Ltd., R., Galt, Ont.
Philadelphia Gear Works, Philadelphia, Pa
Renold (Hans) of Canada, Ltd., Montreal, Que.

Gears, Dressed
Kennedy & Sons, Wm., Owen Sound, Ont.

Gears, Forged
Canada Foundries & Forgings Co., Welland, Ont.
Lyman Tube & Supply Co., Montreal, Que.

Gears, Herringbone
Dom. Steel Products Co., Brantford, Ont.
Hamilton Gear & Machine Co., Toronto, Ont.
Philadelphia Gear Works, Philadelphia, Pa.

Gears, Machine Moulded
Can. Steel Foundries, Montreal, Que.

Gears, Rawhide (See Gears, Cut)
Hamilton Gear & Machine Co., Toronto Ontario
Philadelphia Gear Works, Philadelphia, Pa.

Gear, Silent Chain
Gardner & Son, Robt., Montreal, Que
Morse Chain Co., Ithaca, N.Y.
Can. Link-Belt Co., Ltd., Toronto, Can.
Hans Renold of Canada, Ltd., Montreal, Quebec.

Gears, Worm
Dom. Steel Products Co., Brantford, Ont.
Hamilton Gear & Machine Co., Toronto, Ontario.

Generators, Acetylene
L'Air Liquide Society, Toronto, Ont.

Generators, Electric
Holden Co., Ltd., Montreal, Que.
Northern Electric Co., Montreal, Que.
Petrie, Ltd., H. W., Toronto, Ont.
Sturtevant Co., B. F., Boston, Mass.

Goggles, Safety
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Can., Toronto, Ont
Standard Optical Co., Geneva, N.Y.
Willson Goggles, Inc., Reading, Pa.

Grab Buckets
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Can. Link-Belt Co., Toronto, Ont.
Dominion Bridge Co., Ltd., Lachine, Que.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.

Grease Cups, Pressed Steel and Brass
Can. Winkley Co., Ltd., Windsor, Ont.

Greases, Lubricating
Canadian SKF Co., Toronto, Ont.
Cataract Refining Co., Toronto, Ont.

Grinding Discs
Ritchey Supply Co., Toronto, Ont.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R.I.

Grinding Machines, Abrasive Belt
Beacon Engineering Co., Tipton, England
Norton Co. of Can., Ltd., Hamilton, Ont.

Grinding Machines, Automatic
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Grinding Machines, Bench
Aikenhead Hardware Ltd., Toronto, Ont.
Ford-Smith Machine Co., Hamilton, Ont
Foss Machinery & Supply Co., Geo. F., Montreal, Que
Geometric Tool Co., New Haven, Conn.
Holly, R. S., Toronto, Ont.
La Salle Tool Co., La Salle, Ill.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
McDougall Co., Ltd., R., Galt, Ont.
Norton Co. of Can., Ltd., Hamilton, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Rockford Drilling Machine Co., Rockford, Ill.
Roelefson Machine & Tool Co., Toronto, Ont.
Waltham Grinding Wheel Co. of Canada, Brantford, Ont.
Terry & Co., John C., Birmingham, Eng.
Strelinger Co. of Can., Ltd., Chas. A., Windsor, Ont.
Wilkinson & Kompass, Hamilton, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Grinding Machines, Center
U.S. Electrical Tool Co., Cincinnati, O.
Wiscons'n Electric Co., Racine, Wis.

Grinding Machines Chaser
Jones & Lamson Machine Co Springfield, Vt.

Grinding Machines, Cutter and Reamer
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Garlock-Walker Mchy. Co., Toronto, Ont.
Greenfield Machine Co., Greenfield, Mass.
Herbert Ltd., Alfred, Toronto, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Grinding Machines, Cylindrical
Garlock-Walker Mchy. Co., Toronto, Ont.
Greenfield Machine Co., Greenfield, Mass.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Grinding Machines, Die
Jones & Lamson Machine Co., Springfield, Vermont.
Moeller Machine & Tool Co., Detroit Mich.
National Acme Co., Cleveland, Ohio
National Machinery Co., Tiffin, Ont.

Grinding Machines, Disc
Beacon Engineering Co., Tipton, England.
Ford-Smith Machine Co., Hamilton, Ont.

Grinding Machines, Drill
Beacon Engineering Co., Tipton, England.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Holden Co., Ltd., Montreal, Que.

Grinding Machines, Face
Ford-Smith Machine Co., Hamilton, Ont.

Grinding Machines, Floor and Tool
Beacon Engineering Co., Tipton, England.
Ford-Smith Machine Co., Hamilton, Ont.
Gisholt Machine Co., Madison, Wis.
Modern Tool Co., Erie, Pa.
National Acme Co., Cleveland, Ohio.
Petrie, Ltd., H. W., Toronto, Ont.
Terry & Co., John C., Birmingham, Eng.

Grinding Machines, Internal
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.

Grinding Machines, Portable
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Cincinnati Electrical Tool Co., Cincinnati, Ohio.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Garlock-Walker Mchy. Co., Toronto Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.
Wisconsin Electric Co., Racine, Wis

Grinding Machines, Power Oscillating Tool
Herbert Ltd., Alfred, Toronto, Ont.

Grinding Machines, Ring Wheel
Ford-Smith Machine Co., Hamilton, Ont.

Grinding Machines, Snagging
Norton Co. of Can., Ltd., Hamilton, Ont.

Grinding Machines, Surface
Garlock-Walker Mchy. Co., Toronto Ont
La Salle Tool Co., Ltd., La Salle, Ill.
Petrie, Ltd., H. W., Toronto, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Grinding Machines, Thread
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Grinding Machinery, Tool Post
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Gisholt Machine Co., Madison, Wis.
Wisconsin Electric Co., Racine, Wis.

Grinding Machines, Universal
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Gisholt Machine Co., Madison, Wis.
La Salle Tool Co., Ltd., La Salle, Ill
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Petrie, Ltd., H. W., Toronto, Ont
Roelefson Machine & Tool Co., Toronto, Ont.
Waltham Grinding Wheel Co of Canada Brantford, Ont.

Grinding Wheels
Aikenhead Hardware Ltd., Toronto, Ont.
Atkins & Co., Inc., E. C., Indianapolis, I.
Dom. Abrasive Wheel Co., Ltd., Mimico, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Norton Co. of Can., Ltd., Hamilton, Ont.
Waltham Grinding Wheel Co of Canada, Ltd., Brantford, Ont

Guards, Machinery and Window
Can. Wire & Iron Goods Co., Hamilton, Ont.

Gun-Barrel Machinery
Steinle Turret Machine Co., Madison, Wis.

Hack Saws, Power
Ackworthie, Ltd., John, Birmingham, Eng
Aikenhead Hardware Ltd., Toronto, Ont.
Atkins & Co., Inc., E. C., Indianapolis, I.
Clemson Bros., Hamilton, Canada
Garlock-Walker Mchy. Co., Toronto, Ont.
Lyman Tube & Supply Co., Montreal, Que.
Petrie, Ltd., H. W., Toronto, Ont.
Simonds Canada Saw Co., Montreal, Que
Starrett Co., L S., Athol, Mass
Williams Machinery & Supply Co., A. R., Montreal, Que.

Hammers, Chipping
Cleveland Pneumatic Tool Co., Toronto, Ont.

Hammers, Drop
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs & Co., Ltd., Hamilton, Ont
Canada Foundries & Forgings Co., Welland, Ont.
Canada Machinery Corp., Galt, Ont.

Hammers, Electric
Aikenhead Hardware Ltd., Toronto, Ont.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Holden Co., Ltd., Montreal, Que.

Hammers, Pneumatic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.
Keller Pneumatic Tool Co., Grand Haven, Mich.

Hammers, Power
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Jardine & Co., A. B., Hespeler, Ont
Petrie, Ltd., H. W., Toronto, Ont.

Hammers, Riveting
Cleveland Pneumatic Tool Co., Toronto, Ont.

Hangers, Shafting
Can. Link-Belt Co., Toronto, Ont.
Canadian SKF Co., Toronto, Ont.
Chapman Double Ball Bearing Co., Toronto, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Terry & Co., John C., Birmingham, Eng.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Hardening, Case-Hardening and Tempering
Hamilton Gear & Machine Co., Toronto, Ont.

Hardness Testing Apparatus
Shore Instrument Co., Jamaica, N.Y.

Heating
Skinner Bros. Mfg. Co., Inc., St. Louis, Mo.

Hobbing Machines
Herbert Ltd., Alfred, Toronto, Ont.
Petrie, Ltd., H. W., Toronto, Ont.

Hobs
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Brown & Sharpe Mfg. Co., Providence, R.I.
Greenfield Tap & Die Corp., Galt, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Hoists, Electric
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Can. Link-Belt Co., Toronto, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.
Volta Mfg. Co., Welland, Ont.

Hoists, Hand
Lyman Tube & Supply Co., Montreal, Que.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Wright Mfg. Co., Lisbon, Ohio.

Hoists, Pneumatic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.

Holders-On, Pneumatic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que
Independent Pneumatic Tool, Chicago, Ill.

Hose, Industrial
Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont.
Goodyear Tire & Rubber Co of Can., Ltd., Toronto, Ont.

Hose, Rubber
Can. Consolidated Rubber Co., Ltd., Montreal, Que.
Can. Foamite Firefoam Co., Hamilton, Ont.

Hydraulic Leather
Graton & Knight Mfg. Co., Worcester, Mass.

Hydraulic Machinery
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Stewart & Co., Duncan, Glasgow, Scot.

Hydrogen
National Electro Products, Ltd., Toronto, Ont.

Index Centers
Dickow, Fred. C., Machinery Co., Chicago, Ill.

Igniters, Gas Engine
Canada Foundries & Forgings Co., Welland, Ont.

Indicators, Speed and Test
Aikenhead Hardware Ltd., Toronto, Ont.
Atkins & Co., Inc., E. C., Indianapolis, I.
Brown & Sharpe Mfg. Co., Providence, R.I.

Insulation
Diamond State Fibre Co. of Can., Ltd., Toronto, Ont.

Jacks, Hydraulic
Norton, A. O., Boston, Mass.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.
Starrett Co., L. S., Athol, Mass.

Bilton Machine Co., Bridgeport, Conn.
Burgess & Marchand, Montreal, Que
Crescent Machine Co., Ltd., Montreal, Q.

BUYERS' DIRECTORY

Jigs and Fixtures (See Tool Work)
Fisher Motor Co., Ltd., Orillia, Ont
Ford-Smith Machine Co., Hamilton, Ont.
Gisholt Machine Co., Madison, Wis
Hamilton Engineering Service, Ltd., Hamilton, Ont.
Rapid Tool & Machine Co., Lachine, Que.

Keyseating Machines
Bilton Machine Co., Bridgeport, Conn
Garlock-Walker Mchy. Co., Toronto, Ont.
Morton Mfg. Co., Muskegon, Mich.
Petrie, Ltd., H. W., Toronto, Ont.
Pratt & Whitney Co. of Canada Ltd., Dundas, Ont.

Keys, Machine
Can. Drawn Steel Co., Hamilton, Ont
Garlock-Walker Mchy. Co., Toronto, Ont
Morton Mfg. Co., Muskegon, Mich.

Knives, Machine
Atkins & Co., Inc., E. C., Indianapolis, I
Canada Machinery Corp., Galt, Ont.
Oliver Machy. Co., Grand Rapids, Mich.
Simonds Canada Saw Co., Montreal, Que.

Knurl Holders
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Lacing Leather
Clipper Belt Lacer Co., Grand Rapids, Mich.
Main Belting Co. of Can., Montreal, Que.

Lamps, Electric
Federal Eng'r'ng Co., Ltd., Toronto, Ont.
Northern Electric Co., Montreal, Que.

Lathe Attachments
Canada Machinery Corp., Galt, Ont.
Hendey Machine Co., Torrington, Conn.
Lehmann Machine Co., St. Louis, Mo.
Petrie, Ltd., H. W., Toronto, Ont.

Lathe Pans, Portable
Canada Machinery Corp., Galt, Ont.

Lathe Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Can. Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Gisholt Machine Co., Madison, Wis.
Hendey Machine Co., Torrington, Conn.

Lathes, Automatic and Semi-Automatic
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Gisholt Machine Co., Madison, Wis.
Herbert Ltd., Alfred, Toronto, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
McDougall Co., Ltd., R., Galt, Ont.
National Acme Co., Cleveland, Ohio.
Steinle Turret Machine Co., Madison, Wis.

Lathes, Bench
Archibald & Co., Chas. P., Montreal, Q.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Lathes, Boring
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Steinle Turret Machine Co., Madison, Wis.

Lathes, Chucking (See Lathes, Horizontal Turret, and Lathes, Vertical Turret)
Acme Machine Tool Co., Cincinnati, Ohio.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vermont.
McDougall Co., Ltd., R., Galt, Ont.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

Lathes, Engine
Archibald & Co., Chas. P., Montreal, Q.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Hardinge Bros., Inc., Chicago, Ill.
Herbert Ltd., Alfred, Toronto, Ont.
Hendey Machine Co., Torrington, Conn.
Holly, R. S., Toronto, Ont.
Lehmann Machine Co., St. Louis, Mo.
McDougall Co., Ltd., R., Galt, Ont.
Oliver Machinery Co., Grand Rapids, Mich.
Petrie, Ltd., H. W., Toronto, Ont.
Rockford Lathe & Drill Co., Rockford, Ill
Roelefson Machine & Tool Co., Toronto, Ont.
Sidney Machine Tool Co., Sidney, Ohio.
Strelinger Co. of Can., Ltd., Chas. A., Windsor, Ont.
Walcott Lathe Co., Jackson, Mich.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Lathes, Extension and Gap
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Gisholt Machine Co., Madison, Wis.
McDougall Co., Ltd., R., Galt, Ont.
Oliver Machinery Co., Grand Rapids, Mich

Lathes, Heavy Duty Projectile Boring
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Blashill Wire Machy. Co., Ltd., Montreal
Sidney Machine Tool Co., Sidney, Ohio.
Steinle Turret Machine Co., Madison, Wis.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Lathes, Horizontal Turret
Acme Machine Tool Co., Cincinnati, Ohio
Blount Co., J. G., Everett, Mass.
Gisholt Machine Co., Madison, Wis
Herbert Ltd., Alfred, Toronto, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
McDougall Co., Ltd., R., Galt, Ont.
National Acme Co., Cleveland, Ohio.
Oliver Machinery Co., Grand Rapids, Mich.
Petrie, Ltd., H. W., Toronto, Ont.
Rockford Lathe & Drill Co., Rockford, Ill.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

Lathes, Polishing (See Polishing and Buffing Machines)
Ford-Smith Machine Co., Hamilton, Ont

Lathes, Relieving
Canada Machinery Corp., Galt, Ont.
Hendey Machine Co., Torrington, Conn.
McDougall Co., Ltd., R., Galt, Ont.

Lathe, Universal Hand
Brown & Sharpe Mfg. Co., Providence, R.I.

Lathes, Screw-Cutting
Jones & Lamson Machine Co., Springfield, Vt.

Lathe, Speed and Hand
Garlock-Walker Mchy. Co., Toronto, Ont.
Greenfield Tap & Die Corp., Galt, Ont.
Oliver Machy. Co., Grand Rapids, Mich

Lathes, Spinning
Terry & Co., John C., Birmingham, Eng.

Lathes, Threading
Canada Machinery Corp., Galt, Ont.
Greenfield Tap & Die Corp., Galt, Ont.
Hendey Machine Co., Torrington, Conn.
Lehmann Machine Co., St. Louis, Mo.

Lathes, Vertical Turret
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vermont.
Roelefson Machine & Tool Co., Toronto, Ont.

Lathes, Wood Turning
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Oliver Machinery Co., Grand Rapids, Mich.
Petrie, Ltd., H. W., Toronto, Ont.

Lead Pipe
Steel Co. of Canada, Ltd., Hamilton, Ont

Lighting Fixtures
Northern Electric Co., Montreal, Que.
Tallman Brass & Metal Co., Hamilton, Ont.

Linoleum Mill Machinery
Bertrams Ltd., Edinburgh, Scotland.

Liquid Air Plants
L'Air Liquide Society, Toronto, Ont.

Lockers, Clothes
Can. Foamite Firefoam Co., Hamilton, Ont.
Dennis Wire & Iron Works, London, Ont.

Lubricants
Cataract Refining Co., Toronto, Ont.
Oakley Chemical Co., New York, N.Y.

Lubricating Systems
Bowser, S. F., & Co., Ltd., Toronto, Can.

Machinists' Small Tools
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada.
Bertrams Ltd., Edinburgh, Scotland.
Brown & Sharpe Mfg. Co., Providence, R.I.
Canada Foundries & Forgings Co., Welland, Ont.
Can. Fairbanks-Morse Ltd., Montreal, Q.
Dodge Mfg. Co. of Can., Toronto, Ont
Foss Machinery & Supply Co., Geo. F., Montreal, Que
Ker & Goodwin Machine Co., Brantford, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Pilot Steel & Tool Co., Montreal, Que.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Rapid Tool & Machine Co., Lachine, Que.
Rice Lewis & Son, Ltd., Toronto, Ont
Rockford Milling Machine Co., Rockford, Ill
Starrett Co., L. S., Athol, Mass.
Strelinger Co. of Can., Ltd., Chas. A., Windsor, Ont.
Wheel Trueing Tool Co., Detroit, Mich.
Williams Machinery Co., A. R., Toronto, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Manganese Steel
Can. Steel Foundries, Montreal, Que.

Mandrels, Expanding
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Mandrels, Solid
Atkins & Co., Inc., E. C., Indianapolis, I.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Measuring Machines
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Metals, Alloy
British Smelting & Refining Co., Ltd., Montreal, Que.
Brown's Copper & Brass Rolling Mills, Ltd., Toronto, Ont.
Canada Metal Co., Ltd., Toronto, Ont.
Can. Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Can. Steel Foundries, Montreal, Que.
Deloro Smelting & Refining Co., Ltd., Toronto, Ont.
Fisher Motor Co., Ltd., Orillia, Ont.
Hoyt Metal Co., Toronto, Ont.
International Nickel Co. of Can., Ltd., Toronto, Ont.
Magnolia Metal Co., Montreal, Que.
Moore & Son, Thos., Montreal, Que.
Pilot Steel & Tool Co., Montreal, Que.
Tallman Brass & Metal, Ltd., Hamilton, Ontario.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Metalite Cloth
Ritchey Supply Co., Toronto, Ont.

Micrometer Calipers
Aikenhead Hardware Ltd., Toronto, Ont.
Brown & Sharpe Mfg. Co., Providence, R.I
Rice Lewis & Son, Ltd., Toronto, Ont.

Milling Attachments
Ackworthie, Ltd., John, Birmingham, Eng.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Ford-Smith Machine Co., Hamilton, Ont
Hendey Machine Co., Torrington, Conn.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
Petrie, Ltd., H. W., Toronto, Ont.

Milling Machines
Brown & Sharpe Mfg. Co., Providence, R.I

Milling Machines, Automatic
Bilton Machine Co., Bridgeport, Conn.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Terry & Co., John C., Birmingham, Eng

Milling Machines, Bench
Burke Machine Tool Co., Conneaut, Ohio
Garlock-Walker Mchy. Co., Toronto, Ont.
Rockford Milling Machine Co., Rockford, Ill.
Terry & Co., John C., Birmingham, Eng

Milling Machines, Hand
Burke Machine Tool Co., Conneaut, Ohio
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.
Terry & Co., John C., Birmingham, Eng.
United States Machine Tool Co., Cincinnati, Ohio

Milling Machines, Horizontal and Planer Type
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Can. Fairbanks-Morse Ltd., Montreal, Q
Cleveland Milling Machine Co., Cleveland
Ford-Smith Machine Co., Hamilton, Ont
Gooley Edlund Inc., Cortland, N.Y.
Herbert Ltd., Alfred, Toronto, Ont.
Kearney & Trecker Co., Milwaukee, Wis
Rockford Milling Machine Co., Rockford, Ill.
Roelefson Machine & Tool Co., Toronto, Ont.
Williams Machinery Co., A. R., Toronto, Ont.

Milling Machines, Plain
Bilton Machine Co., Bridgeport, Conn.
Cincinnati Milling Machine Co., Cincinnati, Ohio
Cleveland Milling Machine Co., Cleveland.
Ford-Smith Machine Co., Hamilton, Ont
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Gooley Edlund Inc., Cortland, N.Y.
Hendey Machine Co., Torrington, Conn.
Herbert Ltd., Alfred, Toronto, Ont.
Kearney & Trecker Co., Milwaukee, Wis
Kempsmith Mfg. Co., Milwaukee, Wis.
Petrie, Ltd., H. W., Toronto, Ont.
Rockford Milling Machine Co., Rockford, Ill
Terry & Co., John C., Birmingham, Eng

Milling Machines, Thread
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Milling Machines, Universal
Armstrong-Whitworth of Canada, Ltd., Montreal, Canada
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Ford-Smith Machine Co., Hamilton, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Hendey Machine Co., Torrington, Conn.
Holly, R. S., Toronto, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
Petrie, Ltd., H. W., Toronto, Ont.
Rockford Milling Machine Co., Rockford, Ill
Roelefson Machine & Tool Co., Toronto, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que

Milling Machines, Vertical
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Garlock-Walker Mchy. Co., Toronto, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
Kearney & Trecker Co., Milwaukee, Wis
Kempsmith Mfg. Co., Milwaukee, Wis.
Rockford Milling Machine Co., Rockford, Ill.
Williams Machinery Co., A. R., Toronto, Ont.

Monel Metal
International Nickel Co. of Can., Ltd., Toronto, Ont.

Motors, Electric
Atkins & Co., Inc., E. C., Indianapolis, I.
Garlock-Walker Mchy. Co., Toronto, Ont
MacGovern & Co., Montreal, Que.
Northern Electric Co., Montreal, Que.
Petrie, Ltd., H. W., Toronto, Ont.
Sturtevant Co., B. F., Boston, Mass.
Williams Machinery Co., A. R., Toronto, Ont.
Wisconsin Electric Co., Racine, Wis.

Moulded Rubber Goods
Can. Consolidated Rubber Co., Ltd., Montreal, Que.

Nail Machinery
Sleeper & Hartley Inc., Worcester, Mass

Nails and Staples
Steel Co. of Canada Ltd., Hamilton, Ont

Nickel, Bars, Sheets, Wire, Etc.
International Nickel Co. of Can., Ltd., Toronto, Ont.

Nickel Plating Outfits
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Nickel Silver
Brown's Copper & Brass Rolling Mills, Ltd., Toronto, Ont.

Nitrogen
L'Air Liquide Society, Toronto, Ont

Nut Tappers (See Bolt and Nut Machinery)
Acme Machinery Co., Cleveland, Ohio.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Greenfield Tap & Die Corp., Galt, Ont.
National Acme Co., Cleveland, Ohio.

Nuts, Finished and Semi-finished
Galt Machine Screw Co., Galt, Ont.

Nuts, S.A.E., Plain and Castellated
Galt Machine Screw Co., Galt, Ont.

Oil Filtering and Storage Systems
Bowser, S. F., & Co., Ltd., Toronto, Can.

Oil Storage Engineers
Bowser, S. F., & Co., Ltd., Toronto, Can.

Oils
Canadian Oil Companies, Ltd., Toronto, Ont.
Cataract Refining Co., Toronto, Ont.
Imperial Oil Ltd., Toronto, Ont.

Oil Hole Covers
Can. Winkley Co., Ltd., Windsor, Ont.

Oils, Soluble
Cataract Refining Co., Toronto, Ont.
Imperial Oil Ltd., Toronto, Ont.

Oxygen
Carter Welding Co., Toronto, Ont
Dominion Oxygen Co., Toronto, Ont
L'Air Liquide Society, Toronto, Ont.

Oxy-Acetylene Apparatus
L'Air Liquide Society, Toronto, Ont.

Packing, Hydraulic
Can. Consolidated Rubber Co., Ltd., Montreal, Que.
Graton & Knight Mfg. Co., Worcester, Mass.
Guildford & Sons, Ltd., Halifax, N.S.

Packing, Steam
Can. Consolidated Rubber Co., Ltd., Montreal, Que
Graton & Knight Mfg. Co., Worcester, Mass.
Guildford & Sons, Ltd., Halifax, N.S.

Paper Mill Conveyors
Bertrams Ltd., Edinburgh, Scotland.

Patents
Fetherstonhaugh & Co., Ottawa, Ont.
Marion & Marion, Montreal, Que

Pans, Wet and Dry
Frost Mfg. Co., Chicago, Ill

Pattern-Shop Machinery (See Woodworking Machinery)
Canada Machinery Corp., Galt, Ont
Oliver Machinery Co., Grand Rapids, Mich.

Patterns, Wood and Metal
Crescent Machine Co., Ltd., Montreal, Q.
Victoria Foundry Co., Ltd., Ottawa, Ont.
Wraggis Pattern Works, Galt, Ont.

Penstocks, Steel
MacKinnon Steel Co., Sherbrooke, Que

BUYERS' DIRECTORY

Phosphor Tin
British Smelting & Refining Co., Ltd., Montreal, Que.

Photographic Duplicating Machines
Commercial Camera Co., Providence, R.I.

Pig Iron
Steel Co. of Canada, Ltd., Hamilton, Ont.

Pipe Bending Machines
American Pipe Bending Machine Co., Boston, Mass
Underwood Corp., H. B., Philadelphia, Pa.
Williams Machinery Co., A. R., Toronto, Ont.

Pipe Couplings
Steel Co. of Canada, Ltd., Hamilton, Ont.

Pipe Cutting and Threading Machines
Crane Ltd., Montreal, Que.
Greenfield Tap & Die Corp., Galt, Ont.
Jardine & Co., A. B., Hespeler, Ont.
Landis Machine Co., Inc., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.
McDougall Co., Ltd., R., Galt, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Williams Tool Corp. of Can., Ltd., Brantford, Ont.

Pipe and Nipple Threading Machines
Landis Machine Co., Inc., Waynesboro, Pa.

Pipe Fitters' Tools
Aikenhead Hardware Ltd., Toronto, Ont.
Crane Ltd., Montreal, Que.
Rice Lewis & Son, Ltd., Toronto, Ont.

Pipe Threading Die Heads
Landis Machine Co., Inc., Waynesboro, Pa.

Piston-Ring Machines
National Acme Co., Cleveland, Ohio.
Steinle Turret Machine Co., Madison, Wis.

Planers, Parallels
L. & P. Mfg. Co., Niagara Falls, Ont.

Planing Machines
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Hepburn Ltd., John T., Toronto, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
L. & P. Mfg. Co., Niagara Falls, Ont.
Morton Mfg. Co., Muskegon, Mich.
Oliver Machinery Co., Grand Rapids, Mich.
Williams Machinery Co., A. R., Toronto, Ont.

Planing Machines, Rotary
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.

Plate Rolls
Bertram & Son Co., Ltd., The John, Dundas, Ont.

Pneumatic Tools
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.
Keller Pneumatic Tool Co., Grand Haven, Mich

Polishing and Buffing Machines
Ackworthie, Ltd., John, Birmingham, Eng
Archibald & Co., Chas. P., Montreal, Q.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Hanson & Van Winkle Co., Ltd., Toronto, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Terry & Co., John C., Birmingham, Eng.

Pots, Steel
Swedish Crucible Steel Co. of Canada Ltd., Windsor, Ont.

Pressed Steel Parts
Ackworthie, Ltd., John, Birmingham, Eng.
American Pulley Co., Philadelphia, Pa.
Fisher Motor Co., Ltd., Orillia, Ont.

Presses, Arbor
Atlas Press Co., Kalamazoo, Mich.
National Engineering Co., Sarnia, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Strelinger Co. of Can., Ltd., Chas. A., Windsor, Ont.

Presses, Drop and Forging
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Canada Foundries & Forgings Co., Welland, Ont.
Toledo Machine & Tool Co., Toledo, Ohio.

Presses, Foot and Hand
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Terry & Co., John C., Birmingham, Eng.

Presses, Forcing
Atlas Press Co., Kalamazoo Mich
Stewart & Co., Duncan, Glasgow, Scot.

Presses, Hydraulic
Baird Machine Co., Bridgeport, Conn
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Laurie Mfg. Co., Springfield, Ill.
Perrin Ltd., W. R., Toronto, Ont.
Stewart & Co., Duncan, Glasgow, Scot.
Williams Machinery Co., A. R., Toronto, Ont.

Presses, Power
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Hepburn Ltd., John T., Toronto, Ont.
Henry & Wright Mfg. Co., Hartford, Conn.
Petrie, Ltd., H. W., Toronto, Ont.
Stall Co., Inc., D. H., Buffalo, N.Y.
Toledo Machine & Tool Co., Toledo, Ohio.

Presses, Screw
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Petrie, Ltd., H. W., Toronto, Ont.

Profiling Machines
Aikenhead Hardware Ltd., Toronto, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Protractors
Brown & Sharpe Mfg. Co., Providence, R.I.

Propellers
Kennedy & Sons, Wm., Owen Sound, Ont.

Pulleys, Cork Insert
American Pulley Co., Philadelphia, Pa.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Positive Clutch & Pulley Works, Toronto, Ont.

Pulleys, Metal and Fibre
American Pulley Co., Philadelphia, Pa.
Bernard Industrial Co., A., Fortierville, Que.
Can. Fairbanks-Morse Ltd., Montreal, Q.
Canadian SKF Co., Toronto, Ont.
Diamond State Fibre Co. of Can., Ltd., Toronto, Ont.
Johnson Machine Co., Carlyle, Manchester, Conn.
Kennedy & Sons, Wm., Owen Sound, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Pulp and Paper Mill Equipment
MacKinnon Steel Co., Sherbrooke, Que

Pumps, Automobile Tire
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Pumps, Barrel and Boiler-feed
Trahern Pump Co., Rockford, Ill

Pumps, Circulating and Coalant
Trahern Pump Co., Rockford, Ill

Pumps, Geared and Hand
Trahern Pump Co., Rockford, Ill.

Pumps, Industrial
Trahern Pump Co., Rockford, Ill.

Pumps, Hydraulic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Electric Steel & Engineering Co., Welland, Ont.
Hepburn Ltd., John T., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Stewart & Co., Duncan, Glasgow, Scot.
Trahern Pump Co., Rockford, Ill.

Pumps, Lubricant and Oil
Bowser, S. F., & Co., Ltd., Toronto, Can.
Can. Blower & Forge Co., Ltd., Kitchener.
Hepburn Ltd., John T., Toronto, Ont.
McDougall Co., Ltd., R., Galt, Ont.
Trahern Pump Co., Rockford, Ill.

Pumps, Power
Bowser, S. F., & Co., Ltd., Toronto, Can.
Can. Blower & Forge Co., Ltd., Kitchener.
Can. Fairbanks-Morse Ltd., Montreal, Q.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Hepburn Ltd., John T., Toronto, Ont.
Trahern Pump Co., Rockford, Ill.

Punches, Center
Brown & Sharpe Mfg. Co., Providence, R.I.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Starrett Co., L. S., Athol, Mass.

Punches, Hand
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Can. Blower & Forge Co., Ltd., Kitchener
Jardine & Co., A. B., Hespeler, Ont.

Punches, Power
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Canada Machinery Corp., Galt, Ont.
Can. Blower & Forge Co., Ltd., Kitchener.
Garlock-Walker Mchy. Co., Toronto, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Toledo Machine & Tool Co., Toledo, Ohio

Punching Machines, Horizontal
Bertrams Ltd., Edinburgh, Scotland.

Pyrometers, Electric
Bristol Co., Waterbury, Conn.
General Combustion Co. of Can., Ltd., Montreal, Que.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Racks, Cut
Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Gear & Machine Co., Toronto, Ont.

Racks, Storage (See Furniture, Machine Shop)
Brantford Oven & Rack Co., Brantford, Ont.

Rammers, Foundry
Holden Co., Ltd., Montreal, Que.

Reamer Holders
Cleveland Twist Drill Co., Cleveland, O.
Gisholt Machine Co., Madison, Wis.
Victor Tool Co., Waynesboro, Pa.

Reamers, Expanding
Aikenhead Hardware Ltd., Toronto, Ont.
Can. Detroit Twist Drill Co., Walkerville, Ont.
Cleveland Twist Drill Co., Cleveland, O.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Galt, Ont.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
McCroskey Tool Corp., Meadville, Pa.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Reamers, Solid
Armstrong Whitworth Co. of Can., Ltd., Montreal, Que.
Butterfield & Co., Inc., Rock Island, Que.
Can. Detroit Twist Drill Co., Walkerville, Ont.
Cleveland Twist Drill Co., Cleveland, O.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Greenfield Tap & Die Corp., Galt, Ont.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Reamers, Taper
Butterfield & Co., Inc., Rock Island, Que.
Can. Detroit Twist Drill Co., Walkerville, Ont.
Cleveland Twist Drill Co., Cleveland, O.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Garlock-Walker Mchy. Co., Toronto, Ont.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Galt, Ont.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Pilot Steel & Tool Co., Montreal, Que.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Recorders, Temperature
Taylor Instrument Co., Rochester, N.Y.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Recorders, Time
Gisholt Machine Co., Madison, Wis.
International Business Machines Co., Toronto, Ont.

Regulators, Automatic (for electric furnaces)
Volta Mfg. Co., Welland, Ont.

Rheostats
Northern Electric Co., Montreal, Que.

Resistance Materials
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Respirators
Willson Goggles, Inc., Reading, Pa.

Rivets
Parmenter & Bulloch Co., Gananoque, Ont.
Steel Co. of Canada, Ltd., Hamilton, Ont.

Rivet Heaters
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
General Combustion Co. of Can., Ltd., Montreal, Que.
Volta Mfg. Co., Welland, Ont.

Rivet-Making Machinery
Acme Machinery Co., Cleveland, Ohio.
Bertram & Son Co., Ltd., The John, Dundas, Ont.
National Machinery Co., Tiffin, Ohio.

Riveting Machines
Bilton Machine Co., Bridgeport, Conn.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
High Speed Hammer Co., Rochester, N.Y.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.
Keller Pneumatic Tool Co., Grand Haven, Mich
Parmenter & Bulloch Co., Gananoque, Ont.
Petrie, Ltd., H. W., Toronto, Ont.
Schuster Co., F. B., New Haven, Conn.

Rolling Mill Equipment
Stewart & Co., Duncan, Glasgow, Scot.

Rolls (Rubber Covered)
Can. Consolidated Rubber Co., Ltd., Montreal, Que.

Rudder Frames, Steel
Can. Steel Foundries, Montreal, Que.
Dominion Foundries & Steel, Ltd., Hamilton, Ont.

Rubber Goods, Mechanical
Quaker City Rubber Co., Philadelphia, Pa.

Rules, Steel
Chesterman & Co., Ltd., J., Sheffield, Eng

Rules, Steel and Wood
Brown & Sharpe Mfg. Co., Providence, R.I

Rust Preventatives
Oakley Chemical Co., New York, N.Y.

Sand Equipment
Can. Link-Belt Co., Toronto, Ont.

Sand Mills
Frost Mfg. Co., Chicago, Ill.

Sanding Machinery
Oliver Machy. Co., Grand Rapids, Mich.

Sand Rammers, Pneumatic
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.
Keller Pneumatic Tool Co., Grand Haven, Mich.

Saw Frames and Blades, Hack
Aikenhead Hardware Ltd., Toronto, Ont.
Atkins & Co., Inc., E. C., Indianapolis, I.
Clemson Bros., Inc., Hamilton, Ont.
Diamond Saw & Stamping Works, Buffalo, N.Y.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Rice Lewis & Son, Ltd., Toronto, Ont.
Simonds Canada Saw Co., Montreal, Que

Sawing Machines, Metal
Atkins & Co., Inc., E. C., Indianapolis, I.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Herbert Ltd., Alfred, Toronto, Ont.
Lyman Tube & Supply Co., Montreal, Que.

Sawing Machines, Power Hack
Ackworthie, Ltd., John, Birmingham, Eng.
Atkins & Co., Inc., E. C., Indianapolis, I.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Saw Sharpening Machines
Atkins & Co., Inc., E. C., Indianapolis, I.
Oliver Machinery Co., Grand Rapids, Mich.

Saw Tables, Universal
Atkins & Co., Inc., E. C., Indianapolis, I.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Oliver Machinery Co., Grand Rapids, Mich.
Petrie, Ltd., H. W., Toronto, Ont.

Saws, Circular Metal
Atkins & Co., Inc., E. C., Indianapolis, I.
Simonds Canada Saw Co., Montreal, Que.
Tabor Mfg. Co., Philadelphia, Pa.

Saws, Hand
Aikenhead Hardware Ltd., Toronto, Ont.
Atkins & Co., Inc., E. C., Indianapolis, I.
Simonds Canada Saw Co., Montreal, Que.

Saws, Hot and Cold
Atkins & Co., Inc., E. C., Indianapolis, I
Simonds Canada Saw Co., Montreal, Que.
Stewart & Co., Duncan, Glasgow, Scot

Saws, High Speed Steel
Armstrong Whitworth of Canada Ltd., Montreal, Canada.
Atkins & Co., Inc., E. C., Indianapolis, I.
Butterfield & Co., Inc., Rock Island, Que.
Clemson Bros., Hamilton, Canada.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Simonds Canada Saw Co., Montreal, Que.

Saws, Metal Band
Atkins & Co., Inc., E. C., Indianapolis, I.
Oliver Machinery Co., Grand Rapids, Mich.

Saws, Metal, Power
Clemson Bros., Inc., Hamilton Ont

Saws, Metal Cutting
Atkins & Co., Inc., E. C., Indianapolis, I.
Brown & Sharpe Mfg. Co., Providence, R.I.
Butterfield & Co., Inc., Rock Island, Que
Clemson Bros., Inc., Hamilton, Ont.
Lyman Tube & Supply Co., Montreal, Que.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Simonds Canada Saw Co., Montreal, Que.
Starrett Co., L. S., Athol, Mass.

Saws, Milling
Atkins & Co., Inc., E. C., Indianapolis, I.
Butterfield & Co., Inc., Rock Island, Que.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Saws, Screw Slotting
Atkins & Co., Inc., E. C., Indianapolis, I.
Butterfield & Co., Inc., Rock Island, Que.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Simonds Canada Saw Co., Montreal, Que.

Saws, Swing Cut-off
Oliver Machinery Co., Grand Rapids, Mich.

Scales
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Ltd., Montreal, Q.

Screens
Can. Wire & Iron Goods Co., Hamilton, Ont.

Screw Driving Machine
Canada Machinery Corp., Galt, Ont.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Holden Co., Ltd., Montreal, Que.
Independent Pneumatic Tool, Chicago, Ill.

Screw Extractors
Cleveland Twist Drill Co., Cleveland, O.

BUYERS' DIRECTORY

Screw Machine Work
Barnes Co., Wallace, Bristol, Conn.
Cook Co., Asa S., Hartford, Conn.
National Acme Co., Cleveland, Ohio
Tallman Brass & Metal Co., Hamilton, Ont.

Screw Machinery, Wood and Lag
Cook Co., Asa S., Hartford, Conn.

Screw Machines
Brown & Sharpe Mfg. Co., Providence, R.I.

Screw Machines, Automatic
Garlock-Walker Mchy. Co., Toronto, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
National Acme Co., Cleveland, Ohio.

Screw Machines, Plain or Hand
Acme Machine Tool Co., Cincinnati, Ohio.
Greenfield Tap & Die Corp., Galt, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
Jones & Lamson Machine Co., Springfield, Vermont.
Pratt & Whitney Co. of Canada, Ltd., Dundas, Ont.
Warner & Swasey Co., Cleveland, Ohio.

Screw Plates
Alkenhead Hardware Ltd., Toronto, Ont.
Butterfield & Co., Inc., Rock Island, Que
Greenfield Tap & Die Corp., Galt, Ont.
Jardine & Co., A. B., Hespeler, Ont.

Screws, Cap and Set
Galt Machine Screw Co., Galt, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
National Acme Co., Cleveland, Ohio.

Screws, Machine
Barnes Co., Wallace, Bristol, Conn.
Steel Co. of Canada, Ltd., Hamilton, Ont.

Screws, Safety Set
Barnes Co., Wallace, Bristol, Conn.
Galt Machine Screw Co., Galt, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.

Second-Hand Machinery
(See Searchlight Section)
Petrie, Ltd., H. W., Toronto, Ont.

Separators, Moisture and Oil
Bowser, S. F., & Co., Ltd., Toronto, Can.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que

Separators, Oil and Waste
Bowser, S. F., & Co., Ltd., Toronto, Can.

Shafting
Canada Foundries & Forgings Co., Welland, Ont.
Can. Drawn Steel Co., Hamilton, Ont.
N.S. Steel Co., Ltd., New Glasgow, N.S.
Williams Machinery Co., A. R., Toronto, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Shapes, Cold-Drawn Special Steel
Union Drawn Steel Co., Hamilton, Ont.

Shaping Machines
Canada Machinery Corp., Galt, Ont.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Hendey Machine Co., Torrington, Conn.
Herbert Ltd., Alfred, Toronto, Ont.
Holly, R. S., Toronto, Ont.
Morton Mfg. Co., Muskegon, Mich.
McDougall Co., Ltd., R., Galt, Ont.
Roelefson Machine & Tool Co., Toronto, Ont.
Smith & Mills Co., Cincinnati, Ohio
Walcott Lathe Co., Jackson, Mich.
Williams Machinery Co., A. R., Toronto, Ont.

Shapers, Wood
Oliver Machinery Co., Grand Rapids, Mich.

Shears, Hand
Can. Blower & Forge Co., Ltd., Kitchener.

Shears, Power
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Canada Machinery Corp., Galt, Ont.
Can. Blower & Forge Co., Ltd., Kitchener.
Stall Co., Inc., D. H., Buffalo, N.Y.
Stewart & Co., Duncan, Glasgow, Scot.
Toledo Machine & Tool Co., Toledo, Ohio
Williams Machinery Co., A. R., Toronto, Ont.

Shearing Machines, Angle, Iron Bar and Gate
Bertrams Ltd., Edinburgh, Scotland

Sheet Metal Working Machinery
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Herbert Ltd., Alfred, Toronto, Ont.
Stall Co., Inc., D. H., Buffalo, N.Y.
Terry & Co., John C., Birmingham, Eng.
Toledo Machine & Tool Co., Toledo, Ohio.

Sheets, Nickel, Resist, Alloy
International Nickel Co. of Can., Ltd., Toronto, Ont.

Sheets, Nickel, Monel and Fibre
Diamond State Fibre Co. of Can., Ltd., Toronto, Ont.

Side Frames, Locomotive
Can. Steel Foundries, Montreal, Que.
Dominion Foundries & Steel, Ltd., Hamilton, Ont.

Slotting Attachments
Ford-Smith Machine Co., Ltd., Hamilton, Ont.
Kearney & Trecker Co., Milwaukee, Wis
Kempsmith Mfg. Co., Milwaukee, Wis.
National Acme Co., Cleveland, Ohio.

Slotting Machines
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Foundries & Forgings Co., Welland, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Herbert Ltd., Alfred, Toronto, Ont.

Solders
British Smelting & Refining Co., Ltd., Montreal, Que.
Hoyt Metal Co., Toronto, Canada.

Snap Flasks
Oliver Machy. Co., Grand Rapids, Mich.

Special Machinery and Tools
Brown Engineering Corp., Ltd., Toronto
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.
Crescent Machine Co., Ltd., Montreal, Q.
Ford-Smith Machine Co., Hamilton, Ont.
Gisholt Machine Co., Madison, Wis.
Ingersoll Machine & Tool Co., Ltd., Ingersoll, Ont.
National Acme Co., Cleveland, Ohio.

Spectacles, Industrial
Willson Goggles, Inc., Reading, Pa.

Springs
Barnes Co., Wallace, Bristol, Conn.
Cleveland Wire Spring Co., Cleveland, O
Dunbar Bros. Co., Bristol, Conn.
Steele Ltd., James, Guelph, Ont.

Spring-making Machinery
Sleeper & Hartley Inc., Worcester, Mass.

Sprockets and Chains
Can. Link-Belt Co., Toronto, Ont.
Jones & Glassco, Montreal, Que.
Lyman Tube & Supply Co., Montreal, Que
Morse Chain Co., Ithaca, N.Y.
Renold (Hans) of Canada, Ltd., Montreal, Que.

Squares
Brown & Sharpe Mfg. Co., Providence, R.I.

Stamping, Metal
American Pulley Co., Philadelphia, Pa
Barnes Co., Wallace, Bristol, Conn.
Diamond Saw & Stamping Works, Buffalo, N.Y.
Fisher Motor Co., Ltd., Orillia, Ont.
Keller Pneumatic Tool Co., Grand Haven, Mich.
Parmenter & Bulloch Co., Gananoque, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Stamps, Steel
Diamond Saw & Stamping Works, Buffalo, N.Y.

Stairways, Wrought Iron
Can. Wire & Iron Goods Co., Hamilton, Ont.

Steam Specialties
Crane Ltd., Montreal, Que.

Steel Plate
Dom. Foundries & Steel, Hamilton, Ont.

Steels, Tool
Can. Atlas Crucible Steel Co., Toronto, Ont
Vulcan Crucible Steel Co., Aliquippa, Pa

Steel Blooms and Billets
Steel Co. of Canada, Ltd., Hamilton, Ont.

Steel, Cold-Rolled Strip
Andrews Steel Co., Newport, Ky.
Barnes Co., Wallace, Bristol, Conn.
Can. Driver-Harris Co., Walkerville, Ont.
Firth & Sons, Ltd., Thos., Montreal, Q.

Steel Castings
Dom. Foundries & Steel, Hamilton, Ont

Steel Forgings
Dominion Foundries & Steel, Ltd., Hamilton, Ont.

Steel, Shafting and Free Cutting Screw
Barnes Co., Wallace, Bristol, Conn.
Can. Drawn Steel Co., Hamilton, Ont.
Union Drawn Steel Co., Hamilton, Ont

Steel, Sheet
Dominion Foundries & Steel, Ltd., Hamilton, Ont.
Firth & Sons, Ltd., Thos., Montreal, Q.
Rice Lewis & Son, Ltd., Toronto, Ont.
Steel Co. of Can., Ltd., Hamilton, Ont.
Toronto Iron Works, Toronto, Ont.

Steel, Tanks
Can. John Wood Mfg. Co., Toronto, Ont.

Steel, Stainless
Canadian Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Steel Co. of Can., Ltd., Hamilton, Ont.
Vanadium Alloys Steel, Latrobe, Pa.

Steel Wire Rods
Steel Co. of Canada, Ltd., Hamilton, Ont.

Steels, Alloy, Open Hearth and Electric
Lake Superior Corp., Sault Ste. Marie, Ont.

Steels, Alloy and Carbon
Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont.
Andrews Steel Co., Newport, Ky.
Armstrong Whitworth Co. of Can., Ltd., Montreal, Que.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Barnes Co., Wallace, Bristol, Conn
Canadian Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Can. Driver-Harris Co., Walkerville, Ont.
Can. Steel Foundries, Montreal, Que.
Dom. Foundries & Steel, Hamilton, Ont
Firth & Sons, Ltd., Thos., Montreal, Q.
Dominion Foundries & Steel, Ltd., Hamilton, Ont.
Pilot Steel & Tool Co., Montreal, Que.
Rice Lewis & Son, Ltd., Toronto, Ont.
Steel Co. of Can., Ltd., Hamilton, Ont.
Standard Chain Co. of Canada, Ltd., Welland, Ont.
Ulster Alloy Steel Corp., Canton, Ohio
Vanadium Alloys Steel, Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa

Steels, High-Speed
Armstrong Bros. Tool Co., Chicago, Ill.
Armstrong Whitworth Co. of Can., Ltd., Montreal, Que.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Baines & David, Ltd., Toronto, Ont.
Canada Illinois Atlas Crucible Steel Co., Ltd., Toronto, Ont.
Drury Ltd., H. A., Montreal, Que.
Firth & Sons, Ltd., Thos., Montreal, Q.
Pilot Steel & Tool Co., Montreal, Que.
Rice Lewis & Son, Ltd., Toronto, Ont.
Steel Co. of Can., Ltd., Hamilton, Ont.
Vanadium Alloys Steel, Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa

Steel, Magnet
Can. Atlas Crucible Steel Co., Toronto, Ont.
Vanadium Alloys Steel, Latrobe, Pa.

Steel, Structural
MacKinnon Steel Co., Sherbrooke, Que.

Steel Tubing, Close Joint and Welded
Standard Tube & Fence Co., Ltd., Woodstock, Ont.

Stern Frames, Cast Steel
Can. Steel Foundries, Montreal, Que.
Dominion Foundries & Steel, Ltd., Hamilton, Ont.

Straightening Machinery
Bertrams Ltd., Edinburgh, Scotland

Studs
Galt Machine Screw Co., Galt, Ont.

Surface Plates
Bilton Machine Co., Bridgeport, Conn.

Swaging Machines
Atkins & Co., Inc., E. C., Indianapolis, I

Switches, Railway
Can. Steel Foundries, Montreal, Que.

Switches and Switchboards
Northern Electric Co., Montreal, Que.

Tablets, Bronze, Memorial
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Tachometers
Alkenhead Hardware Ltd., Toronto, Ont
Bristol Co., Waterbury, Conn.

Tanks, Steel
MacKinnon Steel Co., Sherbrooke, Que

Tanks and Pumps, Oil
Bowser, S. F., & Co., Ltd., Toronto, Can.
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que
Toronto Iron Works, Toronto, Ont

Taper Cutting Dies
Jones & Lamson Machine Co., Springfield, Vt.

Tap Holders
Greenfield Tap & Die Corp., Galt, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Taper Pins
Galt Machine Screw Co., Galt, Ont.
Morrow Screw & Nut Co., Ltd., John, Ingersoll, Ont.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Tapes, Measuring
Chesterman & Co., Ltd., J., Sheffield, Eng.
Stanley Co., The L. S., Athol, Mass.

Tapping Machines and Attachments
Ackworthie, Ltd., John, Birmingham, Eng.
Archibald & Co., Chas. P., Montreal, Q.
Burke Machine Tool Co., Conneaut, Ohio
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Galt, Ont.
Jardine & Co., A. B., Hespeler, Ont
National Acme Co., Cleveland, Ohio.
Petrie, Ltd., H. W., Toronto, Ont.
Stanley Co., The L. S., Athol, Mass.

Taps and Dies
Ackworthie, Ltd., John, Birmingham, Eng.
Archibald & Co., Chas. P., Montreal, Q.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Galt, Ont.
International Machinery & Supply Co., Montreal, Que.
Jardine & Co., A. B., Hespeler, Ont.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Acme Co., Cleveland, Ohio
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.
Jardine & Co., A. B., Hespeler, Ont.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Acme Co., Cleveland, Ohio
Victor Tool Co., Waynesboro, Pa.

Teeth, Dredge Bucket
Kennedy & Sons, Wm., Owen Sound, Ont

Testing Metals and Materials
Toronto Testing Laboratory, Toronto, Ont.

Thermometers
Bristol Co., Waterbury, Conn.

Thread-Cutting Tools
Butterfield & Co., B., Rock Island, Que.
Greenfield Tap & Die Corp., Galt, Ont.
Jones & Lamson Machine Co., Springfield, Vermont.
Modern Machine & Tool Co., Detroit, Mich.
National Acme Co., Cleveland, Ohio
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Victor Tool Co., Waynesboro, Pa.

Thread Cutting Machines
Jones & Lamson Machine Co., Springfield, Vermont.
Landis Machine Co., Inc., Waynesboro, Pa.

Threading Machines
Acme Machinery Co., Cleveland, Ohio.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Galt, Ont.
Jones & Lamson Machine Co., Springfield, Vt.
Marchey Machine & Tool Co., Detroit, Mich.
National Acme Co., Cleveland, Ohio
National Machinery Co., Tiffin, Ohio.
Williams Tool Corp. of Can., Ltd., Brantford, Ont.

Thread Lead Testing Machines
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.

Thread-Rolling Machines
Bliss Co., E. W., Brooklyn, N.Y.

Tongs
Hepburn Ltd., John T., Toronto, Ont.

Tool Cases
Rice Lewis & Son, Ltd., Toronto, Ont.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Bilton Machine Co., Bridgeport, Conn.
Gisholt Machine Co., Madison, Wis.
Williams & Co., J. H., Brooklyn, N.Y.

Tool Markers, Electric
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.

Tool Posts, Lathe
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Williams & Co., J. H., Brooklyn, N.Y.

Tool Steels for all Purposes
Canadian Atlas Crucible Steel Co., Ltd., Toronto, Ont.

Tools, Small (See Machinists' Small Tools)
Armstrong Whitworth, of Canada, Ltd., Montreal, Canada.
Armstrong Bros. Tool Co., Chicago, Ill.
Bertrams Ltd., Edinburgh, Scotland.
Burgess & Marchand, Montreal, Que.
Chesterman & Co., Ltd., J., Sheffield, Eng.
Foss Machinery & Supply Co., Geo. F., Montreal, Que.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Galt, Ont.
Hamilton Engineering Service, Ltd., Hamilton, Ont.
Keller Pneumatic Tool Co., Grand Haven, Mich.
Kimber & Hillier Mfg. Co., St. Catharines, Ont.
National Machine Tool Co., Racine, Wis
Rapid Tool & Machine Co., Lachine, Que.
Rice Lewis & Son, Ltd., Toronto, Ont.
Rockford Milling Machine Co., Rockford, Ill.
Stanley Co., The L. S., Athol, Mass.
Strelinger Co. of Can., Ltd., Chas. A., Windsor, Ont
Wheel Trueing Tool Co., Detroit, Mich.
Williams Machinery Co., A. R., Toronto, Ont.
Williams Machinery & Supply Co., A. R., Montreal, Que.

Tool Work
Brown Engineering Corp., Ltd., Toronto.
Crescent Machine Co., Ltd., Montreal, Q.
Ford-Smith Machine Co., Hamilton, Ont.

Torches, Blow
National Electro Products, Ltd., Toronto, Ont.
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Can., Toronto, Ont.
Rice Lewis & Son, Ltd., Toronto, Ont.

Trackwork, Railway
Can. Steel Foundries, Montreal, Que.

Trackwork, Manganese Steel
Can. Steel Foundries, Montreal, Que

Transformers
Northern Electric Co., Montreal, Que.

Transmission Machinery
Bernard Industrial Co., A., Fortierville Que.
Can. Link-Belt Co., Toronto, Ont
Garlock-Walker Mchy. Co., Toronto, Ont
Jones & Glassco, Montreal, Que
Kennedy & Sons, Wm., Owen Sound, Ont
Power Equipment Co., H. W., Toronto, Ont.
Positive Clutch & Pulley Works, Toronto, Ont.
Renold (Hans) of Canada, Ltd., Montreal, Que.

Transportation Systems (See Trucks)
Mathews Gravity Carrier Co., Port Hope, Ont.

Treated Bits
Can. Atlas Crucible Steel Co., Toronto, Ont
Vanadium Alloys Steel, Latrobe, Pa.

BUYERS' DIRECTORY

Trolleys and Tramways
Can Link-Belt Co., Toronto, Ont.
Morris Crane & Hoist Co., Ltd, Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.
Wright Mfg. Co., Lisbon, Ohio.

Trucks
Can. Fairbanks-Morse Ltd., Montreal, Q.
Diamond State Fibre Co., Toronto, Ont.
Hepburn Ltd., John T., Toronto, Ont.
Maple Leaf Mfg. Co., Montreal, Que.
Morris Crane & Hoist Co., Ltd., Niagara Falls, Ont.
National Steel Car Corp., Ltd., Hamilton, Ont.

Trucks, Industrial Motor
Maple Leaf Mfg. Co., Montreal, Que.
National Steel Car Corp., Ltd., Hamilton, Ont.

Tube, Products
Tube Co. of Canada, Toronto, Ont.

Tubing, Electric Welded or Oxy-Acetylene Welded
Tube Co. of Canada, Toronto, Ont.

Tubing, Flexible
Dunlop Tire & Rubber Goods Co., Ltd Toronto, Ont.
Goodyear Tire & Rubber Co of Can., Ltd., Toronto, Ont.

Tubing, Seamless Steel
Tube Co. of Canada, Toronto, Ont.

Tubing, Seamless Steel, Brass and Copper and Fibre
Diamond State Fibre Co. of Can., Ltd., Toronto, Ont.
Dom. Steel Products Co., Brantford, Ont.
Lyman Tube & Supply Co., Montreal, Que.
Tallman Brass & Metal Co., Hamilton, Ont.

Tubing, Welded
International Nickel Co. of Can., Ltd., Toronto, Ont.

Tubing, Welded Steel
Tube Co. of Canada, Toronto, Ont.

Turbines, Water
Kennedy & Sons, Wm., Owen Sound, Ont.

Turret Heads
Ackworthie, Ltd., John, Birmingham, Eng.
Bertram & Son Co., Ltd., The John, Dundas, Ont.

Turret Machines (See Lathes, Horizontal Turret)
Acme Machine Tool Co., Cincinnati, Ohio.
Cook Co., Asa S., Hartford, Conn.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vermont.
National Acme Co., Cleveland, Ohio.
Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

Turrets, Tool Post
Gisholt Machine Co., Madison, Wis.

Unions, Pipe
Crane Ltd., Montreal, Que.

Universal Joints
Ford-Smith Machine Co., Hamilton, Ont.
Holden Co., Ltd., Montreal, Que.

Valves
Can. Fairbanks-Morse Ltd., Montreal Q.
Cleveland Pneumatic Tool Co., Toronto, Ont.
Crane Ltd., Montreal, Que.
Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont.
Goodyear Tire & Rubber Co of Can., Ltd., Toronto, Ont.

Vises, Drilling Machine
Hoosier Drilling Mach. Co., Goshen, Ind.
Kempsmith Mfg. Co., Milwaukee, Wis.

Vises, Metal Workers'
Aikenhead Hardware, Ltd., Toronto, Ont
Columbia Hdwe. Division, Cleveland, O

Vises, Milling Machine
Brown & Sharpe Mfg. Co., Providence, R.I.
Crescent Machine Co., Ltd., Montreal, Q
Ford-Smith Machine Co., Hamilton, Ont.
Hendey Machine Co., Torrington, Conn.
Hoosier Drilling Mach. Co., Goshen, Ind.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.

Vises, Pipe
Columbia Hdwe. Division, Cleveland, O.
Greenfield Tap & Die Corp., Galt, Ont.

Vises, Planer and Shaper
Bertram & Son Co., Ltd., The John, Dundas, Ont.
Hendey Machine Co., Torrington, Conn.
Hoosier Drilling Mach. Co., Goshen, Ind.
Kempsmith Mfg. Co., Milwaukee, Wis.
McDougall Co., Ltd., R., Galt, Ont
Superior Machine Co., London, Ont.

Vises, Wood Workers'
Columbia Hdwe. Division, Cleveland, O.
Foss Machinery & Supply Co., Geo F., Montreal, Que.
Oliver Machy. Co., Grand Rapids, Mich
Victor Tool Co., Waynesboro, Pa.
Parmenter & Bullock Co., Gananoque, Ont.

Voltmeters
Bristol Co., Waterbury, Conn.
Northern Electric Co., Montreal, Que.

Wagon Loaders
Can Link-Belt Co., Toronto, Ont

Washers
Barnes Co., Wallace, Bristol, Conn.
Diamond State Fibre Co., Toronto, Ont.
Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont.
Goodyear Tire & Rubber Co of Can., Ltd., Toronto, Ont.
Graton & Knight Mfg. Co., Worcester, Mass.
McLaren Belting Co., J. C., Montreal, Que.
Steel Co. of Canada, Ltd., Hamilton, Ont.

Washers, Rubber
Can. Ingersoll-Rand Co., Ltd., Sherbrooke, Que.

Welding Apparatus, Oxy-Acetylene
L'Air Liquide Society, Toronto, Ont.

Welding, Electric
All-Weld Company, Toronto, Ont.
Carter Welding Co., Toronto, Ont.
Lincoln Electric Co., Toronto, Ont.
National Electro Products, Toronto, Ont.

Welding Filler Rods
L'Air Liquide Society, Toronto, Ont.
National Electro Products, Ltd., Toronto, Ont.
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Can., Toronto, Ont.

Welding Machines, Oxy-Acetylene
Davis-Bournonville Co., Jersey City, N.J
Holden Co., Ltd., Montreal, Que.
L'Air Liquide Society, Toronto, Ont.
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Can., Toronto, Ont.

Welding, Oxy-Acetylene
Carter Welding Co., Toronto, Ont.
Davis-Bournonville Co., Jersey City, N.J.
Holden Co., Ltd., Montreal, Que.
Lincoln Electric Co., Toronto, Ont.
National Electro Products, Toronto, Ont.
Prest-O-Lite Co. of Can., Toronto, Ont.
Union Carbide Co. of Can., Welland, Ont.

Welding Rod, Tobin, Manganese Bronze and Aluminum
Tallman Brass & Metal, Ltd., Hamilton, Ont.

Welding Supplies
British Smelting & Refining Co., Ltd., Montreal, Que.
Carter Welding Co., Toronto, Ont.
Davis-Bournonville Co., Jersey City, N.J
L'Air Liquide Society, Toronto, Ont.
Lincoln Electric Co., Toronto, Ont.
National Electro Products, Toronto, Ont.
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Canada, Ltd., Toronto, Ont.
Union Carbide Co. of Can., Welland, Ont.

Wheels, Cast, Steel
Dominion Foundries & Steel, Ltd., Hamilton, Ont

Wheels, Industrial
American Pulley Co., Philadelphia, Pa.
Hull Iron & Steel Foundries, Hull, Que.
Kennedy & Sons, Wm., Owen Sound, Ont.

Winches, Electric
Volta Mfg. Co., Welland, Ont.

Winches, Headgate
Kennedy & Sons, Wm., Owen Sound, Ont.

Winches, Stoplog
Kennedy & Sons, Wm., Owen Sound, Ont.

Wire
Barnes Co., Wallace, Bristol, Conn.
Canada Metal Co., Ltd., Toronto, Ont.
Dennis Wire & Iron Works, London, Ont
Greening Wire Co., B., Hamilton, Ont.
Northern Electric Co., Montreal, Que.

Wire Cloth
Can Wire & Iron Goods Co., Hamilton, Ont.

Wire Coiling Machinery
Sleeper & Hartley, Inc., Worcester, Mass.

Wire Rope
Can. Wire & Iron Goods Co., Hamilton, Ont.

Wire Straightening and Cutting Machinery
Baird Machine Co., Bridgeport, Conn.
Brown, Boggs & Co., Ltd., Hamilton, Ont.
Schuster Co., F. B., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

Wire, Welding
L'Air Liquide Society, Toronto, Ont.
National Electro Products, Ltd., Toronto, Ont.
Perdue, W. B., San Francisco, Calif.
Prest-O-Lite Co. of Can., Toronto, Ont.
Tallman Brass & Metal Co., Hamilton, Ont

Wires, Special
Dennis Wire & Iron Works, London, Ont.
Greening Wire Co., B., Hamilton, Ont.
Walker & Sons Metal Products, Ltd., Hiram, Walkerville, Ont.

Woodworking Machinery
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Mchy. Co., Toronto, Ont.
Oliver Machinery Co., Grand Rapids, Mich.
Williams Machinery Co., A. R., Toronto, Ont.

Wrenches, Drop Forged
Armstrong Bros. Tool Co., Chicago, Ill.
Canada Foundries & Forgings Co., Welland, Ont.

Wrenches, Machinists'
Armstrong Bros. Tool Co., Chicago, Ill.
Canada Foundries & Forgings Co., Welland, Ont.

Wrenches, Pipe
Canada Foundries & Forgings Co., Welland, Ont.
Crane Ltd., Montreal, Que.
Greenfield Tap & Die Corp., Galt, Ont.

Wrenches, Tap
Butterfield & Co., Inc., Rock Island, Que.
Greenfield Tap & Die Corp., Galt, Ont.

Wrought Iron Pipe
Steel Co. of Canada, Ltd., Hamilton, Ont

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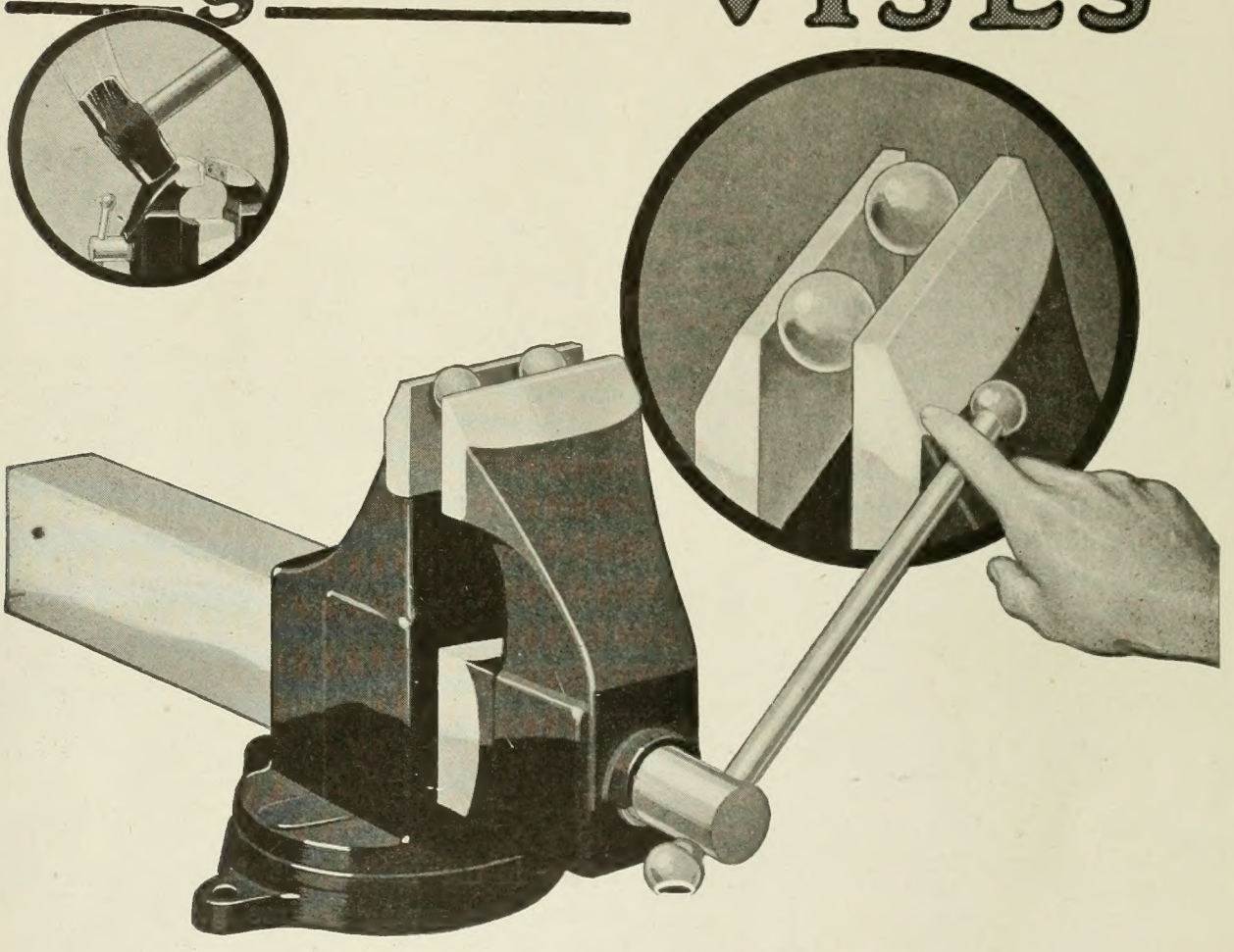
COLUMBIAN

Sledge-Tested VISES



Will Your Vise Do This?

NO one expects a vise to be made with micrometer accuracy. Yet the jaws of this Columbian Sledge-Tested Vise are so nearly parallel that when two steel balls of equal size are placed in the vise the minimum compression required to hold one ball will be just enough to hold the other.

This particular vise has smooth jaw facings, which makes the test more difficult than with the roughened jaws which are used on all Columbian Vises of machinists' type.

Of course, this is an unusual test for a tool with a tolerance of .002" and it is likely that out of the hundreds of thousands of Columbian Vises in use the world over, there are some that will not easily stand so rigid a test, but the majority of Columbian Vises will.

Skilled mechanics demand the Columbian Vise for exacting work. The extra large, carefully fitted beam not only keeps the jaws parallel but slides freely and without play.

Columbian machinists' vises are the only malleable iron vises made and are twice as strong as cast iron. The famous Sledge-Test proves this.

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